

Transport for the North Board Chief Executive Consultation Call Agenda

Date of Meeting	Wednesday 14 December 2022
Time of Meeting	10.30 am
Venue	Virtual

Filming and broadcast of the meeting

This meeting is not a formal meeting of the Transport for the North Board but is being held as a Consultation Call by the Chief Executive under the delegated powers of the Chief Executive to take action in consultation with Members of the Transport for the North Board. Following the Consultation Call the Chief Executive will take delegated actions having regard to the consultation.

The Agenda and reports for the Consultation Call are being made available to the public and the Call is being livestreamed on the Transport for the North website to ensure openness and transparency. Members of the Board will attend the Call virtually.

Item No.	Agenda Item	Page
1.0	Welcome & Apologies The Chair to welcome Members and the public to the meeting. Lead: Chair	
2.0	Declarations of Interest Members are required to declare any personal, prejudicial or disclosable pecuniary interest they may have relating to items on the agenda and state the nature of such interest. Lead: Chair	
3.0	Minutes of the Previous Meeting (5 mins) To approve the minutes of the meetings held on 29 September 2022 (including updates on agreed matters as appropriate). Lead: Chair	5 - 16

4.0	<p>Appointment of Finance Director (10 mins)</p> <p>To receive and consider the recommendation of the Appointment Sub-Committee.</p> <p>Lead: Martin Tugwell</p>	17 - 20
5.0	<p>Northern Powerhouse Independent Economic Review (NPIER) Update (15 mins)</p> <p>To receive an update on the emerging output from the update of the NPIER and consider the implications for the preparation of the Strategic Transport Plan.</p> <p>Lead: Brian Sloan</p>	21 - 34
6.0	<p>Strategic Transport Plan Development (20 mins)</p> <p>To consider and comment on the core narrative and key messages for the Strategic Transport Plan.</p> <p>Lead: Lucy Jacques</p>	35 - 60
7.0	<p>The Future of Rail in the North (50 mins)</p> <p>To consider a draft proposition for the future of rail in the North.</p> <p>Lead: David Hoggarth</p>	61 - 76
8.0	<p>Business Planning 2023-24 (15 mins)</p> <p>To consider and agree priorities for the 2023/24 Business Plan, including consideration of the implications of the November Financial Statement.</p> <p>Lead: Paul Kelly</p>	77 - 84
9.0	<p>Transport and Health Policy Position (20 mins)</p> <p>To consider and agree the policy position</p> <p>Lead: Tom Jarvis</p>	85 - 206
10.0	<p>Date and Time of Next Meeting</p> <p>The next meeting will be held on Thursday 23 March 2023 at 10.30am – 1.00pm in Leeds.</p>	

Transport for the North Board Minutes

29 September 2022
Manchester City Council, Town Hall Extension

Present:

Lord McLoughlin (Chair)

Attendee

Cllr Craig Browne
Cllr Keith Little
Mayor Andy Burnham

Cllr Mike Ross
Cllr Charles Edwards
Cllr Liam Robinson
Cllr Martin Gannon
Cllr Richard Hannigan
Mayor Jamie Driscoll
Cllr Keane Duncan
Cllr Hans Mundry

Local Authority

Cheshire East;
Cumbria;
Greater Manchester Combined
Authority;
Hull;
Lancashire;
Liverpool City Region;
North East Combined Authority;
North Lincolnshire;
North of Tyne Combined Authority;
North Yorkshire;
Warrington;

Rail North Authorities Attendees

Councillor John Ogle Nottinghamshire

Local Enterprise Partnership (LEP) Attendees

Alyson Armett Cumbria LEP
Mark Rawstron Lancashire LEP
Amir Hussain Leeds LEP
Matthew Lamb North Yorkshire LEP
Peter Kennan South Yorkshire Mayoral Combined
Authority LEP

Partners in Attendance:

Nick Bisson DfT
Lorna Pimlott HS2
David Stones National Highways
Neil Holm Network Rail
John Read Network Rail
Tim Shoveller Network Rail

Officers in Attendance:

Name	Job Title
Martin Tugwell	Chief Executive
Gary Rich	Democratic Services Officer
David Spilsbury	Finance Controller
Paul Kelly	Interim Finance Director
Stephen Hipwell	Head of HR
Julie Openshaw	Head of Legal
Owen Wilson	Head of Major Roads
Tim Foster	Interim Strategy & Programme Director
Peter Cole	Principal Environmental and Sustainability Officer
Tom Jarvis	Senior Evidence & Analysis

Item No: **Item**

1. Welcome & Apologies

- 1.1 The Chair welcomed Members and apologies were noted from Mayors Coppard, Houchen and Brabin, Cllrs Phil Riley, Lynn Williams, Neal Brookes, Louise Gittins Jonathan Owen, Claire Holmes, Stewart Swinburn, Jonathan Dulston, Susan Hinchcliffe, Keith Aspden, Andy D'Agorne, Daniel Jellyman, Audra Wynter, Denise Rollo and Mr. Justin Kelly.
- 1.2 The Chair explained that following the changes in Government he has already written to the new Secretary of State and hopes to meet her in the near future.
- 1.3 The Head of Legal explained that whilst the meeting was quorate in terms of numbers, the Members present together did not yet hold the required proportion of the weighted vote required by the Constitution until the anticipated arrival of Mayor Burnham later in the meeting when this part of the quorum requirement would also be satisfied. She advised that meantime it was possible for a motion to be moved without notice and approved by those present to temporarily suspend the weighted vote requirement until the additional Members had arrived and suggested this would be a way to allow the meeting to proceed in a quorate manner.
- 1.4 The Head of Legal's suggestion was proposed by Cllr Edwards and seconded by Cllr Gannon and duly approved.
- 1.5 The Chair proposed that items 4 & 5 be taken later in the agenda due to the presenter having been delayed.

2. Declarations of Interest

- 2.1 The Chair restated his Interest as Chairman of Airlines UK (this has previously been recorded as an interest).

- 2.2 Mr. Amir Hussain declared an interest in relation to his company which is involved in the Southern Gateway Scheme in Bradford.

3. Minutes of the Previous Meeting

- 3.1 The minutes of the meeting of the Transport for the North Board held on 30 June 2022 were considered and approved as a correct record.

The Chief Executive updated Members on the actions undertaken since the last meeting. He informed Members that the Business Plan has now been published and the Chair on behalf of the Board has written to the Secretary of State in relation to HS2 as well as writing to the new Prime Minister and new Secretary of State. A TfN response has also been provided to the consultation on draft legislation for GBR following consultation with Members.

Resolved:

That the minutes of the Transport for the North Board held on 30 June 2022 be approved as a correct record.

4. Integrated Rail Plan: Transport Select Committee Report

- 4.1 In introducing the item, the Chair highlighted to the Board the Transport Select Committee's report which was published in July and observed that he considered it to be a good report, one which he thought TfN can support. He explained to Members that the Government will have to provide a response to the Committee's report, but that this is likely to be delayed due to the changes happening in Government.
- 4.2 Members received the report and the presentation from the Interim Policy and Programme Director who highlighted the key points in the presentation.
- 4.3 Members raised a number of issues and were keen that committed schemes should be started on site as soon as possible in order for the full economic benefits of NPR to begin to be realised.
- 4.4 Cllr Robinson emphasised the political consensus that exists on building in full the HS2 and the NPR schemes. He asked about the communications strategy of TfN on this matter in order to ensure that these pledges are included in future party manifestos, as well as stressing the importance of TfN continuing to make the case to DfT for TfN's preferred network.
- 4.5 Mayor Driscoll stated that the core purpose of TfN is the economic prosperity of the North including inclusivity and environmental sustainability. He explained that economic growth would not be achieved if companies are unable to move their goods around and people are unable to travel and supported the need for commitment to a driver training academy in the North.

He highlighted the damage that train cancellations do to passenger confidence and the negative impact they have on the ability to grow the economy.

- 4.6 Cllr Edwards and Cllr Little raised the issue of the Golborne link and expressed their concern at its deletion without a suitable alternative being in place. They sought clarity from the DfT as to the current position in relation to appraising alternatives.
- 4.7 Mayor Burnham expressed the hope that the new Government's commitment to delivering NPR in full will reinvigorate the Board. Greater Manchester will be hosting the Convention of the North in January 2023 and he believes that this will provide an opportunity to set out the big vision and the growth story around it. He also referred to the lack of a levelling up assessment from the previous Government when decisions were initially taken in respect of the Integrated Rail Plan.
- 4.8 In response to the issues that Members had raised Mr. Nick Bisson stated that the NPR Business Case needs to be refreshed following the publication of the Integrated Rail Plan. The supporting analysis has been commissioned from TfN and should be available by the end of the year. The Board was also assured that new Ministers are keen to engage.

On the issue of the Golborne Link he confirmed alternatives are being worked upon but he was unable to provide timelines and stated that he would return to Board on this. He also hoped that the Leeds – Sheffield Study Terms of Reference will be published soon.

Resolved:

- 1) That the Board welcomes the Transport Select Committee's report
- 2) That the Board sets out to the Secretary of State its desire to work with her in responding to the Committee's recommendations
- 3) That TfN seeks an early discussion with the new Government following commitments made during the summer to deliver NPR in full.

5. TransPennine Upgrade

- 5.1 Members received the report from the Investment Sponsor Manager and the presentation from Mr. Neil Holm and Mr. John Read who explained the current position regarding the Transpennine Route Upgrade (TRU).
- 5.2 The Chair set out the importance of TfN being re-instated onto Programme Board and added that this request will be made again at the meeting with the new Secretary of State. He raised the issue of closures in order to undertake work and stressed the importance of giving the public adequate knowledge of them and reasons for the work.

- 5.3 Cllr Robinson sought clarity on additional freight capacity and enquired as to whether W12 gauge clearance will be available. He also raised the issue of communication when the works are taking place and stressed the importance of communicating across the country that the North is still open for business despite the work taking place.
- 5.4 Mr. Peter Kennan highlighted that some of the diversionary routes have capacity issues and requested that communication on this work needs to be at a regional level in order that constituent authorities can communicate with their travelling public over any disruption.
- 5.5 Cllr Edwards suggested that first recommendation in the report should 'welcome' the DfT's funding announcement trebling investment in TRU rather than 'noting' it.
- 5.6 Mayor Burnham sought clarity on what Northern Powerhouse Rail means for TRU as currently the extent of NPR is uncertain in light of commitments made during the summer. He also raised the issue of the timeline and full benefit realisation and was open to further discussions on what can be done to accelerate progress with delivery of the project.
- 5.7 The Chair stated that there is a growing view in the industry that extended blockades in order to undertake work (as opposed to overnight/weekend working) are the quickest way for projects to progress.
- 5.8 Mr. Nick Bisson explained that TRU can be looked at in three phases; firstly, Marsden to Huddersfield with much of this phase having wider benefits particularly for freight outputs; secondly, Leeds to York, and thirdly Ravensthorpe to Leeds which is the phase needing the most development and design work.
- 5.9 In response to Members' questions and comments Mr. Holm confirmed that they have a requirement to design and develop a scheme for W12 gauge. On the issue of communication, he explained that there is a PR campaign currently running in order to gain engagement and advocacy for the programme. He also stated that there would be communication around planned disruption two to three months prior to work starting and once the work has started there would be customer service support staff available.

Regarding the timelines of the project, he explained that work is taking place with the train operators and would welcome a conversation on ways programme can be accelerated.

Mayor Burnham asked for information to come back to the Board with options for acceleration.

Resolved:

- 1) That the Board welcomes the Department for Transport (DfT) funding announcement trebling investment in TRU.
- 2) That the Board notes the National Audit Office (NAO) TRU report which has identified a clear case for investment but recognises significant risks to the programme's progress that could cause further disruption if the DfT, Network Rail and the Government fail to work together to manage challenges and deliver the expected benefits for rail users.
- 3) That Board welcomes the establishment of the TRU Stakeholder Forum which is Chaired by TfN, but stresses the importance of TfN being a member of the TRU Programme Board.

6. Socially Inclusive Transport Strategy

- 6.1 Members received the report from the Senior Evidence & Analysis Officer who outlined the key elements of his report.
- 6.2 Cllr Edwards stated that TfN should be mindful of this piece of work when putting together business cases for future infrastructure investment and this should be considered in those business planning processes. A number of suggestions were made as to how transport can be made more socially inclusive including; cheaper fares on bus and rail, and car insurance and why this is more expensive in the North. He also suggested that the report should have greater focus on the issues experienced in rural communities.
- 6.3 Mr. Peter Kennan raised the issue of buses and stated that this work is a good example of how TfN can help local areas in discussions with Government on this issue. He believes that the figures quoted in the report continue to worsen as a result of continuing cuts in bus services.

He stated that whilst it is a vital piece of work it now needs to be used in order to help influence the required changes.
- 6.4 Mayor Driscoll was pleased to see safety included in the strategy and believes that if public transport is to be grown then this is a vital issue. He also suggested that the safety of staff should also be included.
- 6.5 Cllr Duncan expressed concern about the methodology used within the strategy and how it appears to be presenting a better view than is in fact the case in rural areas regarding social exclusion.
- 6.6 Cllr Little highlighted the importance of the car in enabling the public in rural areas to go about their business.
- 6.7 Mr. Amir Hussain highlighted the importance of walkable neighbourhoods to unlocking social inclusion.
- 6.8 Cllr Hannigan suggested that the officer group consults with Directors of Public Health and wider integrated health services. He also raised the

issue of buses in rural areas and suggested looking at communal transport.

- 6.9 Mr. Mark Rawstron highlighted the great economic benefits in addressing this issue and asked for the report to address it in stronger terms. He also requested that consultation take place with the business community.
- 6.10 Cllr Robinson raised the issue of affordability of public transport and stressed the importance of having the correct funding packages in place for the rail and bus industries as well as a regulatory framework. He believes that this piece of work should present an opportunity to argue for a price regulator in the bus industry.
- 6.11 In response to Members' comments the Senior Evidence & Analysis Officer stated that data sharing is now available. On the issue of rural areas he commented that it is an analytically complex issue to address. He explained that the urban rural fringe category is the most at risk and that he would change the presentation of the data around this as well as considering changing the presentation in the data tool. He confirmed that a revised version of the strategy will be taken to consultation based on Members' feedback.

Resolved:

That the Board approves the Socially Inclusive Transport Strategy for public consultation.

7. Connected Mobility

- 7.1 Members received the report from the Chief Executive who highlighted the key elements of the report.
- 7.2 Cllr Mundry requested that Warrington be involved in the multi-operating ticketing scheme. Cllr Browne stated that officers in Cheshire East had not yet been contacted.
- 7.3 The Chief Executive stated that he would address these issues following the meeting. He explained that as part of Business Planning process for 2023 -24 TfN is looking at opportunities to develop its support for partners. He added that the new ministerial team are interested in the social and environmental aspects of the transport agenda and that this work will provide an opportunity for TfN to make the case for the North grounded in the relevant evidence.

Resolved:

That the report be noted.

8. International Connectivity Policy Statement

- 8.1 Members received the report from the Interim Policy and Programme Director who highlighted the key points of the report.

- 8.2 Mr. Mark Rawstron expressed concern about the “faster further” option and demand management. He was concerned that taking this position would be seen as supporting the national moratorium on runway development and that such a position will lead to previous airport capacity that has been closed being unable to be brought back into service.
- 8.3 In addressing the concerns of Mr. Rawstron, the Interim Policy and Programme Director stated that TfN will continue to monitor the situation. He advised that he will report back any issues on this at the December Board as part of the Strategic Transport Plan report before it becomes part of the statutory document.
- 8.4 The Chair commented that TfN should be concentrating on issues that impact on transport issues in the North rather than getting involved in national policy.

Resolved:

That Board agrees the International Connectivity & Aviation Policy Position.

9. Rail North Committee Update

- 9.1 Members received the report of the Strategic Rail Director and Cllr Robinson (Chair of the Rail North Committee) highlighted the key points and updated Members on the current situation.
- 9.2 Cllr Robinson explained that there needs to be a key focus on the operational performance of the train operators. He added that the reason for poor performance is because of a mix of different reasons and not just industrial action. He then stressed the importance of the operators delivering on their commitments of returning to their proposed service portfolio and stated that should they not meet the targets then their position will be untenable.
- Cllr Robinson provided an update on his and the Chair’s meeting with the previous Rail Minister Wendy Morton MP. The meeting had been productive and they were able to emphasise the importance of rail in the North being funded properly in order to avoid the kind of funding gaps that are emerging for Northern and Transpennine Express. He highlighted the consequences of these funding gaps not being addressed with the likelihood of services that were cut during the pandemic not being re-instated and possibly more frontline services being cut.
- 9.3 Mayor Burnham was skeptical that the operators are doing all they can and highlighted the loss of confidence that people are having in trains in the North. He highlighted that the poor service is having a major impact on rail users lives and safety. On the issue of Avanti, he requested that TfN should state its position.

- 9.4 Mayor Driscoll stated that investors are reluctant to invest in the North because of the issues with trains and it is affecting confidence. He further stated that operators can't hide behind the issue of industrial relations as a reason for poor service as this is an issue that can be solved.
- 9.5 Cllr Edwards explained that he believes that industrial relations have not helped and pleaded for operators and unions to get back around the table and resolve this matter.
- 9.6 Cllr Little stated that Network Rail also needs to take responsibility for some of the cancellations due to infrastructure failure.
- 9.7 Regarding industrial relations Cllr Robinson stated that both Unions and Senior Management in the train operators are keen to work out a negotiated settlement but they have not been provided the flexibility from the DfT to do this and any deals need to be approved by the DfT.
- 9.8 Mr. Tim Shoveler stated that no one within the industry believes that the current situation is acceptable or sustainable; railways can only work well when everything works together. He highlighted actions that need to be taken in the short term, these included the Network Rail planning team and the operators ensuring that they are providing good customer information when trains are cancelled. He added that the key focus needs to be continuing to work with the Trade Unions in order to resolve the current situation.

The Chair stated that there are separate issues in what Members discussed; there is the disruption caused by the industrial action and then there is the issue of the service of Avanti. The Chair stated that he will write to the Department for Transport on behalf of the Board requesting a tighter and more detailed recovery plan for Avanti against which performance can be monitored.

The Chief Executive suggested that the letter should also include a request to the Department asking them to give operators the flexibility to negotiate some short-term solutions with the Unions.

Resolved:

- 1) That Board notes the update on rail matters
- 2) That Board endorsed the work with DfT and RNP on recovery plans for train operators including both short and long-term solutions to the current issues with the availability of suitably trained drivers with the appropriate route knowledge. Progress will be monitored by the Rail North Committee.
- 3) That Board endorses work with Rail North Partnership to develop plans for a Rail Academy for the North to provide a pipeline of trained drivers to address the current challenges by positive action in the North. The training academy could also be the first step for a more comprehensive approach to public transport skills including bus and tram drivers.

- 4) That Board endorse use of existing and newly-commissioned (through the TAME team) analysis to make the case for investment in the North's railway to support a growing railway and wider objectives such as reduced transport social exclusion and decarbonisation.
- 5) That Board endorses collaborative working with operators to promote the return to rail to help grow new markets and make rail more sustainable.

10. Annual Accounts

- 10.1 Members received the report of the Finance Director. The Board was informed that in order to sign off the accounts the external auditors require the Pension Fund to be signed off before the accounts can be approved. The Finance Director envisaged no problems with this and anticipated that it would be completed by the end of October. As a result of this he stated that the recommendation in the report be altered to say that 'the accounts be approved subject to the sign off of the pension fund and it require no changes to the accounts.' Should modifications be required the process will be repeated and it be brought back to Board.
- 10.2 Members received the Audit and Governance Annual report from Cllr Little (Vice Chair of Audit & Governance Committee) who highlighted the key areas within the report.

Resolved:

- 1) That the Board approves the corporate governance review and the Annual Governance Statement.
- 2) That Board note that TfN's draft statement of accounts was laid open to public inspection for the statutory period without objection being raised.
- 3) That Board notes the recommendation in the Annual Progress Report of the Audit & Governance Committee to approve the Statement of Accounts for 2021/22.
- 4) That the Statement of Accounts for financial year 2021/22 be approved subject to the sign off of the pension fund.

11. Corporate Risk Register and Risk Management Strategy Report

- 11.1 Members received the report from the Interim Finance Director who highlighted the key points within the report.

Resolved:

That Board note the updates to the key organisational risks and the risk management strategy.

12. Organisational Design Update and Governance

- 12.1 Members received the report of the Head of Legal Services. The Chief Executive outlined the key points within the report.

Resolved:

- 1) That Board notes TfN's revised Senior Management Structure (Director Level);
 - 2) That Board notes the current status of Director level recruitment as a result of the revised senior management structure;
 - 3) That Board approves the establishment of an Appointments Sub-Committee of the General Purposes Committee with the membership and Terms of Reference as set out in the report;
 - 4) That Board approves the delegation of authority for annual objective setting for TfN's Chief Executive to the General Purposes Committee.
- 12.2 The Chair thanked the Director of Business Capabilities, who is shortly leaving Transport for the North, for all her hard work since joining at the organisation at its inception.

13. Date and Time of Next Meeting

Wednesday 14 December 2022
10.30am

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Meeting: Transport for the North Board Chief Executive Consultation Call
Subject: TfN Director Appointments
Author: Stephen Hipwell, Head of Human Resources
Sponsor: Martin Tugwell, Chief Executive
Meeting Date: Wednesday, 14 December 2022

1. Purpose of the Report:

- 1.1 To consider and resolve upon the appointment of the Statutory Officer role of Finance Director (including S151 Officer) and to note other recent director-level appointments to the roles of Rail & Roads Director and Strategy, Policy & Communications Director. The Board is further asked to note the progress in relation to the adoption of revised annual objective setting arrangements for both TfN's Chief Executive and Independent Chair.

2. Recommendations:

- 2.1 That the Board:
1. **Approves** the appointment of Paul Kelly, Finance Director (S151 Financial Officer) from 15 December 2022 and notes the intention of the Chief Executive in consultation with the Head of Human Resources to use delegated authority already approved under the Constitution to confirm the interim appointment made from 17 March 2022 as permanent from 15 December 2022.
 2. **Notes** that TfN's Chief Executive will agree the Finance Director's probationary objectives and monitor performance.
 3. **Notes** the appointment of Darren Oldham to the role of Rail & Roads Director and Katie Day to the role of Strategy, Policy & Communications Director, both appointments effective from 6 February 2023.
 4. **Notes** the revised annual objective setting arrangements which have been adopted for TfN's Chief Executive and Independent Chair.

3. Appointment of Finance Director (S151 Financial Officer):

- 3.1 At the 29 September 2022 meeting, the Board approved the process for recruiting a permanent Finance Director (including the S151 Officer role), establishing an Appointment Panel made-up of a Sub-Committee of TfN's General Purposes Committee (GPC) to carry out the recruitment process and recommend a preferred candidate to the Board.
- 3.2 As Board members will recall the previous Finance Director, Iain Craven, left TfN in March 2022 and as resolved by the Board on 25 January 2022 in order to put in place a seamless transition and meet the legal requirement to have a designated S151 Officer throughout, TfN's Financial Controller, Paul Kelly, was designated to this role on an interim basis from 17 March 2022 until a permanent appointment could be completed.
- 3.3 The membership of the Appointment Panel (Sub-Committee of TfN's GPC) was as follows:
- Councillor Keith Little
 - Councillor Mike Ross
 - Councillor Claire Holmes

- Peter Kennan, South Yorkshire Mayoral Combined Authority - LEP - Observer Capacity
- Martin Tugwell - TfN Chief Executive - Observer Capacity

The Preferred Candidate:

- 3.4 Having now completed a comprehensive search and selection process, the Appointment Panel unanimously identified Paul Kelly as its preferred candidate. The Panel is therefore recommending that the TfN Board approves this appointment.
- 3.5 As set out above, Mr Kelly is currently acting as TfN's Interim Finance Director including the S151 Officer role and was the unanimous choice of the Appointment Panel following completion of the final selection process which included a panel interview, candidate presentations and psychometric (leadership) assessments.
- As a qualified accountant with over 25 years' experience Mr Kelly has been with TfN since early 2020, initially in the role of Financial Controller and more recently as Interim Finance Director. Prior to joining TfN, Mr Kelly served as Head of Financial & Commercial for Metrolink (part of Transport for Greater Manchester) for over 11 years, having previously worked at a senior level, across variety of commercial, financial, and operational service roles within both public and private entities over his earlier career.
- 3.6 All other required pre-engagement checks including receipt of satisfactory references, medical clearance and right to work in the UK have been completed.
- 3.7 In usual circumstances, an in-person Board meeting would have received a report recommending the permanent appointment of a statutory officer. Due to external factors an in-person meeting is not possible on this occasion. However, the Board has already appointed Mr Kelly to the role on an interim basis, and the Chief Executive has delegated power within the Constitution to take any action which is required as a matter of urgency in the interests of Transport for the North in consultation where practicable with the Chair or the Members of TfN. In the circumstances that power is wide enough, subject to consultation with Members (which is being undertaken through this report), to enable the interim appointment previously confirmed by Board at an in-person meeting to be made permanent. Therefore, subject to this Board consultation it is proposed that Paul Kelly be appointed as TfN's permanent Finance Director (including S151 Officer) with effect from 15 December 2022. As with all such new appointments, continuation in post will be contingent on the satisfactory completion of a six-month probationary period which will be overseen by TfN's Chief Executive.

Appointments to other TfN Director Roles:

- 3.8 Alongside completion of recruitment to the above Statutory Officer role, TfN has also completed the required search and selection processes to secure appointments to the newly established senior-level roles of Rail & Roads Director (Deputy CEO) and Strategy, Policy & Communications Director.
- As Board members will recall, these roles were created as a result of the realignment of TfN's senior management structure, which was undertaken in light of our FY2022/23 budget settlement.
- 3.9 Following completion of the final selection processes (including adoption of Member-Led Selection Panels), Darren Oldham will join TfN as Rail & Roads Director and Katie Day as Strategy, Policy & Communications Director, both will join TfN on 6 February 2023.
- 3.10 Mr Oldham will be joining TfN from WSP where he is currently an Executive Director, having also held the roles of Head of Planning and Head of Transport Planning for the organisation. Mr Oldham has over 30 years of experience in

planning, regeneration and transport sectors and is a qualified Chartered Transport Planner.

Ms Day has over 20 years' experience of both the public and private sectors, having worked at the Department of Business, Innovation and Skills (BIS) as leading on the Regional Growth Fund and at the Department of Energy and climate Change (DECC). She joins TfN from the Office for Nuclear Regulation, where she is currently Director of Policy & Communications.

- 3.11 As with all such appointments, both appointees will be subject to a thorough induction process, which will include early engagement with Board Members. Continuation in post will also be contingent on the satisfactory completion of respective six-month probationary periods, which will be overseen by TfN's Chief Executive.

TfN Chief Executive & Chair Annual Objective Setting:

- 3.12 At the 29 September 2022 meeting, the Board agreed to delegate the responsibility for the setting and management of annual performance objectives for TfN's Chief Executive to TfN's General Purpose Committee (GPC). Aligned to this decision, the November meeting of the GPC agreed a suitable process for annual objective setting alongside proposed objectives for TfN's Chief Executive for the remainder of FY2022/23 which were subsequently agreed.

The matter of future annual objective setting for TfN's Independent Chair was also considered and aligned to these discussions it is intended that the annual objective setting process agreed for TfN's Chief Executive will also be adopted for TfN's Chair with annual objectives for both role holders in future being agreed by the GPC on behalf of the wider TfN Board.

4. Corporate Considerations:

Financial Implications

- 4.1 There are no new financial implications as a result of this report.

Resource Implications

- 4.2 The resource implications have been considered and addressed within the report.

Legal Implications

- 4.3 The legal implications have been considered and addressed within the report.

Risk Management and Key Issues

- 4.4 The risk management and key issues have been considered and addressed within the report.

Environmental Implications

- 4.5 No environmental impact.

Equality and Diversity

- 4.6 There are no equality and diversity implications as a result of this report.

Consultations

- 4.7 There was no Consultation required.

5. Background Papers:

- 5.1 There are no background papers.

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Meeting: Transport for the North Board Chief Executive Consultation Call
Subject: Northern Powerhouse Independent Economic Review
Author: Brian Sloan, Interim Research Manager
Sponsor: Tim Foster, Interim Strategy and Programme Director
Meeting Date: Wednesday 14th December 2022

1. Purpose of the Report:

- 1.1 To provide an update on the Northern Powerhouse Independent Economic Review (NPIER) programme, specifically detailing the work on the ongoing refresh element of the programme.

2. Recommendations:

- 2.1 It is recommended that the Board:
- a) Expresses deep concern at the widening of the productivity gap between the North and other parts of the UK
 - b) Calls on Government to recognise the urgency of investing in the North to maintain current infrastructure and service levels
 - c) Notes the next stages of finalising the refresh of the NPIER and the intention to publish alongside the Strategic Transport Plan (STP)

3. Main Issues

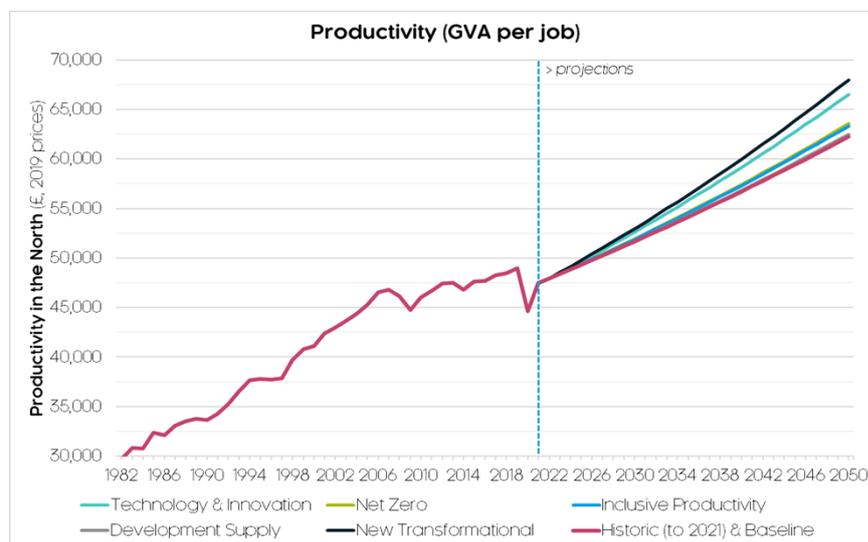
- 3.1 The NPIER was published in 2016 and identified seven key sectoral capabilities in the North that had the potential to support transformational growth in the region if supported by policy initiatives such as investment in improving transport connectivity, skills, R&D, encouraging graduate retention and inward investment. By doing this the North could close the productivity gap with the rest of England and generate an additional £100bn GVA per year and create an additional 850,000 jobs by 2050 compared to a “business as usual” trajectory.
- 3.2 The NPIER was instrumental in framing the scale of economic opportunity in the first STP for the North of England and showing how investment in improving connectivity can drive growth. The NPIER is fully embedded in the transport plans and economic strategies of authorities across the North of England. An update of the NPIER was commissioned by TfN in 2021 in advance of the refresh of TfN’s STP, taking into account the significant changes in the near and longer-term outlook since the original publication.
- 3.3 The programme to update the NPIER is taking place in close collaboration with Northern Partners, including Local Transport Authorities (LTAs) and Local Enterprise Partnerships (LEPs). This work will provide the critical evidence to inform the economic objectives within the refresh of the STP currently being progressed by officers. The refresh builds on the extensive programme of research undertaken by TfN and the wider partnership about the scale of economic potential that could be unlocked and what would be required to deliver on that potential.
- 3.4 This development process and supporting research has resulted in a set of scenarios that present the case for transformational growth in the North, that is socially inclusive and meets the legal requirement to decarbonise the economy. Alongside a baseline “business as usual” scenario, the four scenarios are:
- a) A net zero scenario with a strong focus on green innovation and growth;

- b) Technology transformation, supporting research & innovation and entrepreneurialism and technology adoption;
- c) Inclusive productivity, interventions to support the health, well-being and skills of the Northern workforce;
- d) Development supply, designed to boost the supply of commercial property and domestic housing.

The four scenarios, when combined as a package of policy interventions create a new transformational vision of the economic outlook for the North.

4. Emerging conclusions and implications

- 4.1 The emerging findings from the analysis clearly show a widening of the productivity gap between the North and other parts of the UK since 2016, making the closing of the gap harder to achieve by 2050.
- 4.2 In the revised baseline “business as usual” scenario productivity growth in the North continues to trail that of the rest of England (excluding London) meaning lower levels of prosperity for Northern households. Baseline projections under “business as usual” show the likelihood of stronger employment growth by 2050, but lower than required GVA growth if we are to close the productivity gap or increase prosperity for households. This is because overall UK productivity has stagnated.
- 4.3 The findings show the continued importance of the seven “prime and enabling capabilities” of the North’s economy, defined in the 2016 Review, particularly energy, advanced manufacturing, some professional services and higher education. The scenarios also highlight a number of emerging, wider sectoral strengths in the North including engineering & construction, food & agriculture.
- 4.4 Also demonstrated is the significance of the North’s foundational economy, estimated to currently employ 67% of the North’s workforce and generating 63% of all economic output. The foundational economy describes businesses and organisations that provide essential goods and services, including transport infrastructure, services such as health and social care, and food production. In the early stages of this refresh work, exemplar providers of essential goods and services were found in the North, concentrated in public services, such as health and social care. These were found to provide good coverage, reliability and quality in the North compared to the rest of England and exhibit strong growth and job creation in the scenario outcomes.
- 4.5 Modelling of the individual scenarios all demonstrate positive outcomes for the North by 2050, although the degree to which each influences the outcome for productivity, jobs and growth varies depending on the policy/scenario focus.
- 4.6 When adopted and modelled together (in the fully transformational scenario) the ambition for the North surpasses the scale of the ambition for GVA growth and job creation set in the original 2016 work and also surpasses the level of productivity by 2050 of the rest of England (excluding London). There are also significant implications population growth and housing. To deliver the full transformational scenario there would need to be a substantial increase in the population of the North and the additional number of dwellings to be constructed by 2050, which would further require additional investment in infrastructure such as transport and digital connectivity.
- 4.7 The draft projections for productivity (GVA per job) are compared in the chart below:



5. Emerging Implications

- 5.1 For TfN, the economic ambition in the forthcoming STP should continue to focus on closing the productivity gap, with the work on scenarios helping to identify the required policy changes and investment in infrastructure and services. In practice the direct implications for connectivity and transport investment will be broadly similar to the conclusions of the 2016 Review. The STP is the subject of a further paper to this Board meeting.
- 5.2 More widely, further focus and effort will be required around wider policy levers including as education, skills, housing, and R&D. Both the NPIER and STP are clear that whilst transport investment can be a critical catalyst for growth and prosperity, it is the combination of investment that is required to deliver outcomes and that must be brought together and coordinated at the level of place.
- 5.3 For example, on skills, we know the transport industry faces a twin challenge of an ageing workforce and excess demand for critical STEM skills. But those challenges are shared with many of the prime and enabling capabilities such as digital, advanced manufacturing where we also need to see growth. That points to a concerted effort to promote investment in secondary and post 16 education as the Northern Powerhouse Partnership and others have highlighted.
- 5.4 That requires a much wider conversation with Northern stakeholders beyond the remit of this Board, as well as active engagement with government, and TfN is working with the NP11 and GMCA to bring the fuller conclusions of the NPIER refresh to the Convention of the North planned to be held in Manchester in January 2023.

6. Wider Policy Connections

- 6.1 What the refresh of the NPIER highlights is the need to align TfN's activities in the transport sector with activities in other areas of public policy. For example, it highlights the importance of investment in skills. There is increasing evidence of the extent to which the lack of available skills in the construction sector is impacting on the ability to deliver agreed investment.
- 6.2 TfN's work on Electric Vehicle Charging Infrastructure has involved the energy sector (both generation and distribution) as an integral part of the team developing the framework: a reflection of the need for investment in energy systems to be aligned with that being made in transport if we are to decarbonise the transport system.

- 6.3 In a similar vein the growing reliance on user centred transport solutions on the availability of ubiquitous digital connectivity – both fixed and mobile – serves to emphasise the need for investment in digital infrastructure to be aligned with that being made in transport. In addition, the availability of ubiquitous digital connectivity will support further change in the business models used by public and private sector companies to enable people to access their services and products.
- 6.4 Such considerations reinforce the importance of embracing a 'systems approach' when identifying the need for investment in strategic infrastructure, one that enables the transport system to unlock the North's economic potential.
- 6.5 TfN, with its extensive evidence base and body of technical work is well placed to act as both a catalyst and a champion for promoting the critical importance of systems thinking.

7. Next steps

- 7.1 The consultants are working to finalise the model outcomes, which include a more detailed suite of metrics containing detailed socio-economic and environmental indicators at the level of the North, and more detailed results for each LEP area.
- 7.2 The final outputs from the modelling work and research will be used to inform the implications for the North's transport system and feed into the drafting of the new STP. We envisage sharing the final NPIER outputs with the Partnership Board in February. The final outputs of the research will then be published in the Spring as part of the STP evidence base.
- 7.3 As in para 5.4, TfN is working with NP11 on the Convention for the North as the opportunity to discuss the wider implications of the findings in more depth.
- 7.4 Subject to resources being available in 2023/24, TfN intends to update the TfN Future Travel Scenarios to fully explore the connectivity and travel demand implications of the new NPIER modelled scenarios.

8. Corporate Considerations:

8.1 *Financial Implications.*

The commission to cover this update is in the 2022/23 budget.

8.2 *Resource Implications.*

Internal project management for the commission is fully resourced.

8.3 *Legal Implications.*

The work described helps enable TfN to fulfil its statutory duty and exercise its powers.

8.4 *Risk Management and Key Issues.*

Risks related to the commission have been recorded in the relevant risk register. In addition, risks associated with the Second STP are included on the corporate risk register and there are mitigation actions in relation to NPIER.

8.5 *Environmental Implications*

This report does not constitute or influence a plan or programme which sets the framework for future development consents of projects listed in the EIA Directive and therefore does stimulate the need for SEA or EIA.

8.6 *Equality and Diversity.*

None associated with this update.

8.7 *Consultations.*

None.

9. Background Papers:

9.1 There are no background papers to be included with this update.

10. Appendices:

10.1 There are no appendices to this report.

Glossary of terms, abbreviations and acronyms used (*if applicable*)

a) NPIER	<i>Northern Powerhouse Independent Economic Review</i>
b) TfN	<i>Transport for the North</i>
c) GVA	<i>Gross Value Added</i>
d) STP	<i>Strategic Transport Plan</i>
e) LEP	<i>Local Enterprise Partnership</i>
f) R&D	<i>Research and Development</i>
g) GMCA	<i>Greater Manchester Combined Authority</i>

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NPIER Refresh Programme Update

Scrutiny Committee 23 November 2022

Page 25

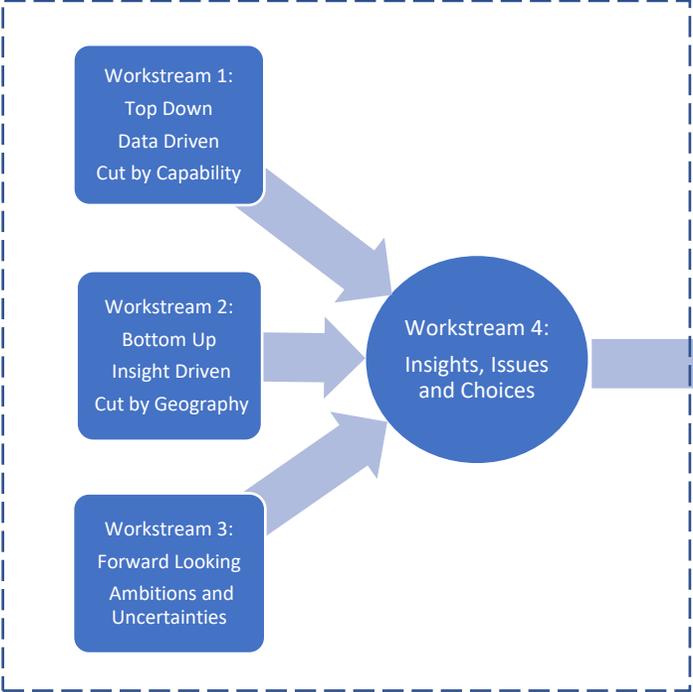


Northern Powerhouse Independent Economic Review Programme

- Collaboration across TfN, LEPs and Central Government
- NPIER published June 2016:
 - Defined seven key sectoral capabilities in the North
 - Identified £100bn pa additional GVA and an extra 850k jobs in transformational scenario
- Now undertaking a refresh programme in the context of:
 - TfN's role as a statutory body
 - Changing economic and political context since the 2016, and longer term economic outlook
- Refreshed NPIER (Autumn 2021 – end 2022) in collaboration with Northern Partners
 - Will provide critical evidence to inform the Strategic Transport Plan refresh

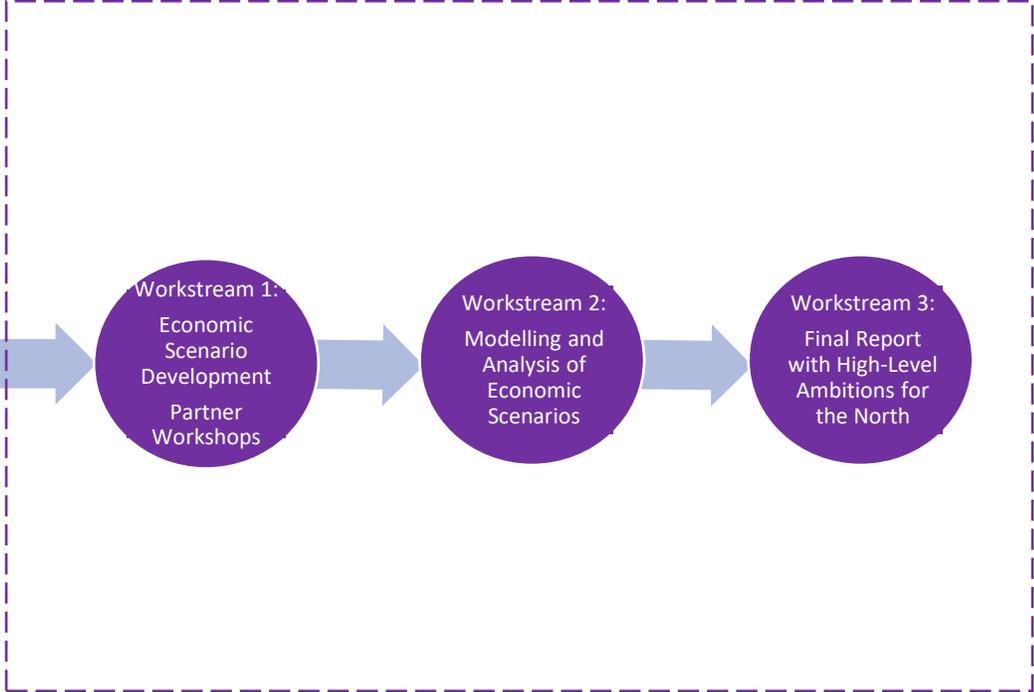
NPIER Refresh Programme – Two Commissions

Capabilities, Local Data and Narratives



November 2021 to May 2022

Economic Scenario Development



May to December 2022

Workstream 1 – Scenario Framework

Benchmarks



Change Scenarios



Adjusted Ambition

Baseline: BAU
What is the outlook for 2050 based on reasonable current assumptions?

Productivity Ambition
What would the outturn and rate of growth be if the North closed the productivity gap by 2050?

Investment Input
What would the outturn be if public investment in the North matched the rest of the UK over time?

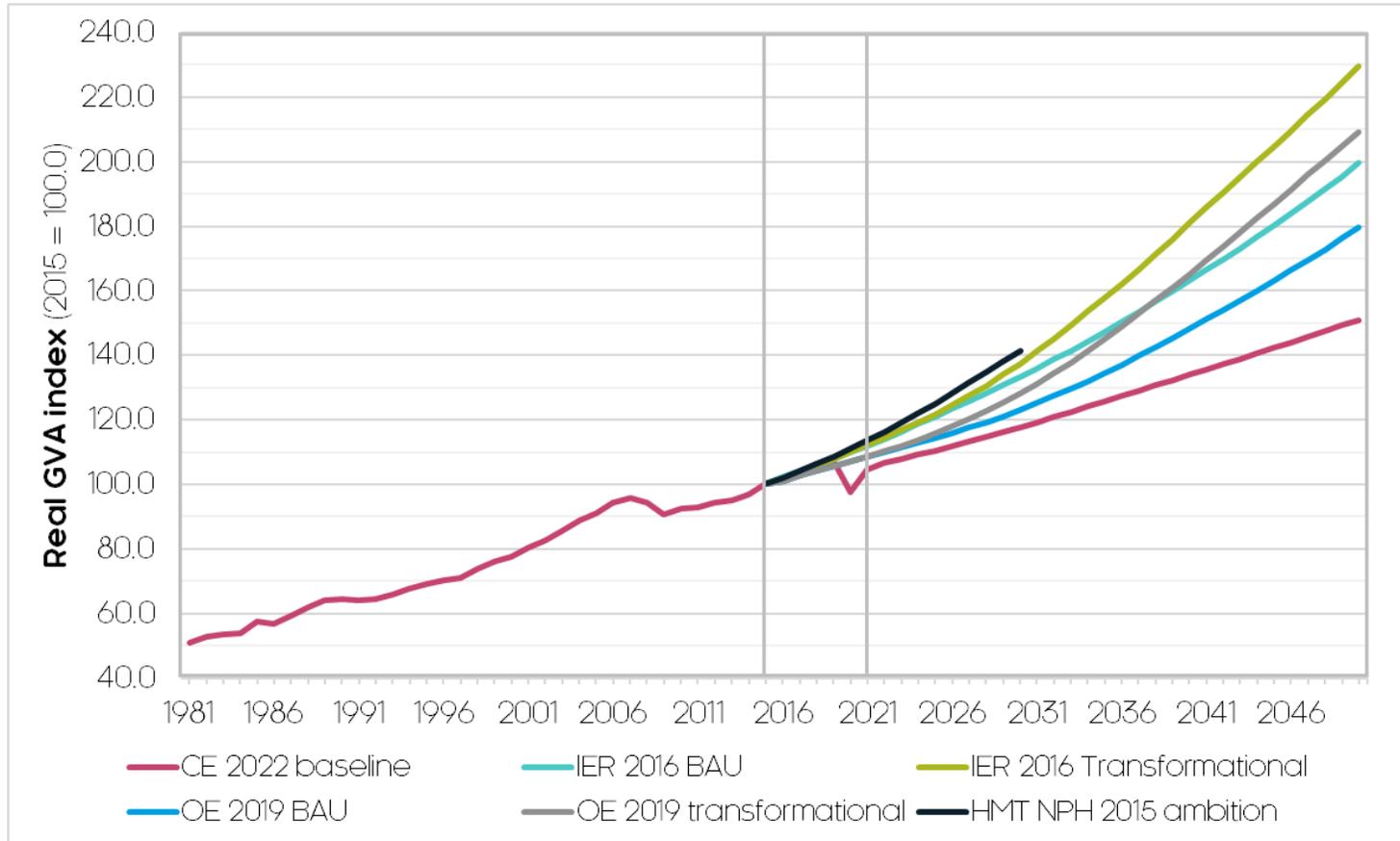
Technology Transformation

Inclusive Productivity

Market Supply

Adjusted Productivity Ambition
Productivity ambition adjusted in light of the potential 'levers and ambitions'

Workstream 2 – Baseline GVA Projection



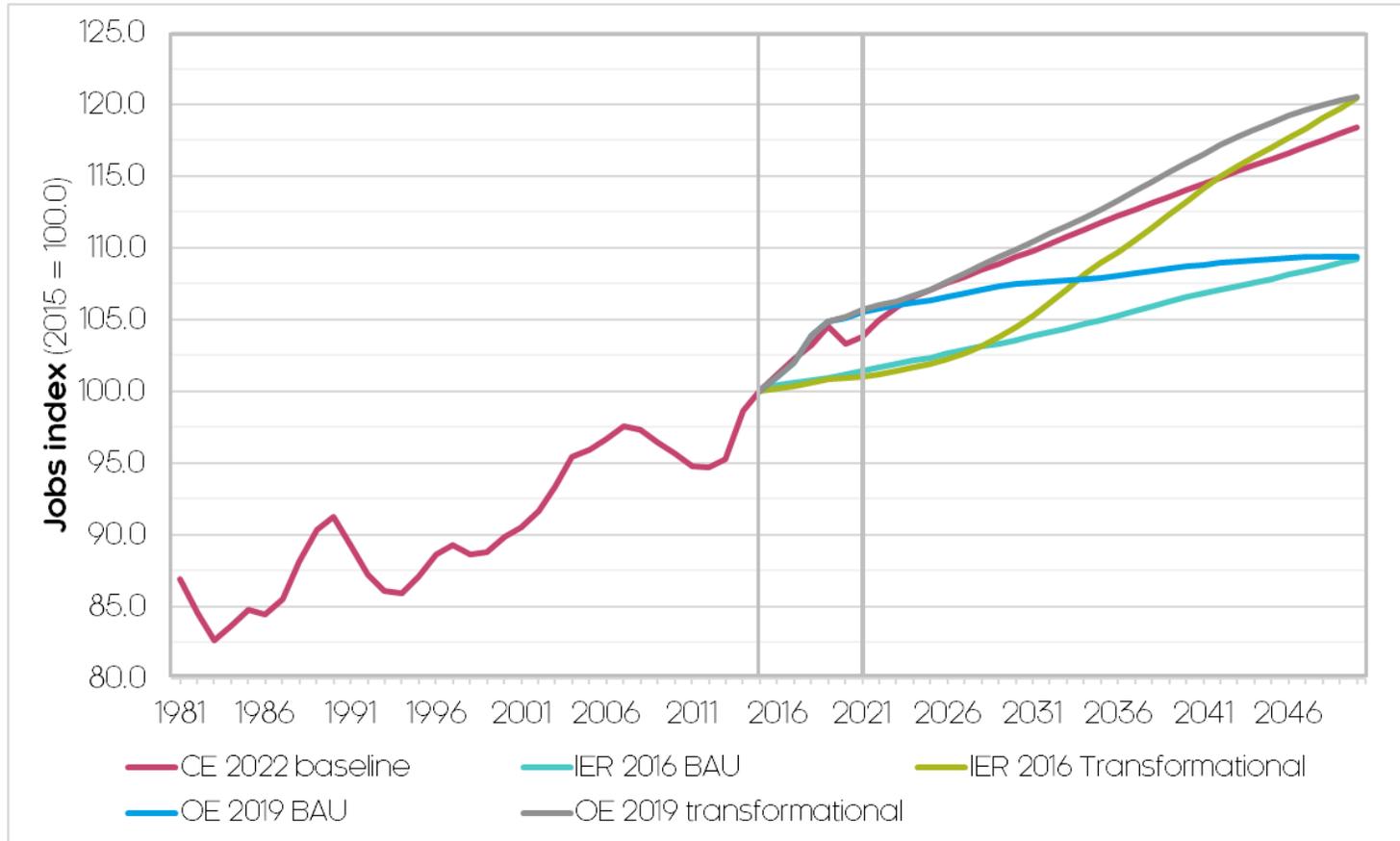
- Outlook for GVA however much more pessimistic than previous projections
- Cambridge Econometrics '22 baseline 50% lower than NPIER BAU, 30% lower than Oxford Economic BAU in 2019
- Largely due to less optimistic productivity outlook
- Productivity forecasts over past decade consistently proven to be over-optimistic
- 'Low and slow' productivity growth now an accepted assumption
- Oxford Econometrics forecasts were already moving in that direction

Source: various (Cambridge Econometrics, Oxford Economics, Northern Powerhouse IER)

Note: projections have been indexed to 2015 to allow comparison across different sources, timeframes etc.

GVA presented in real terms

Workstream 2 – Baseline Job Projection

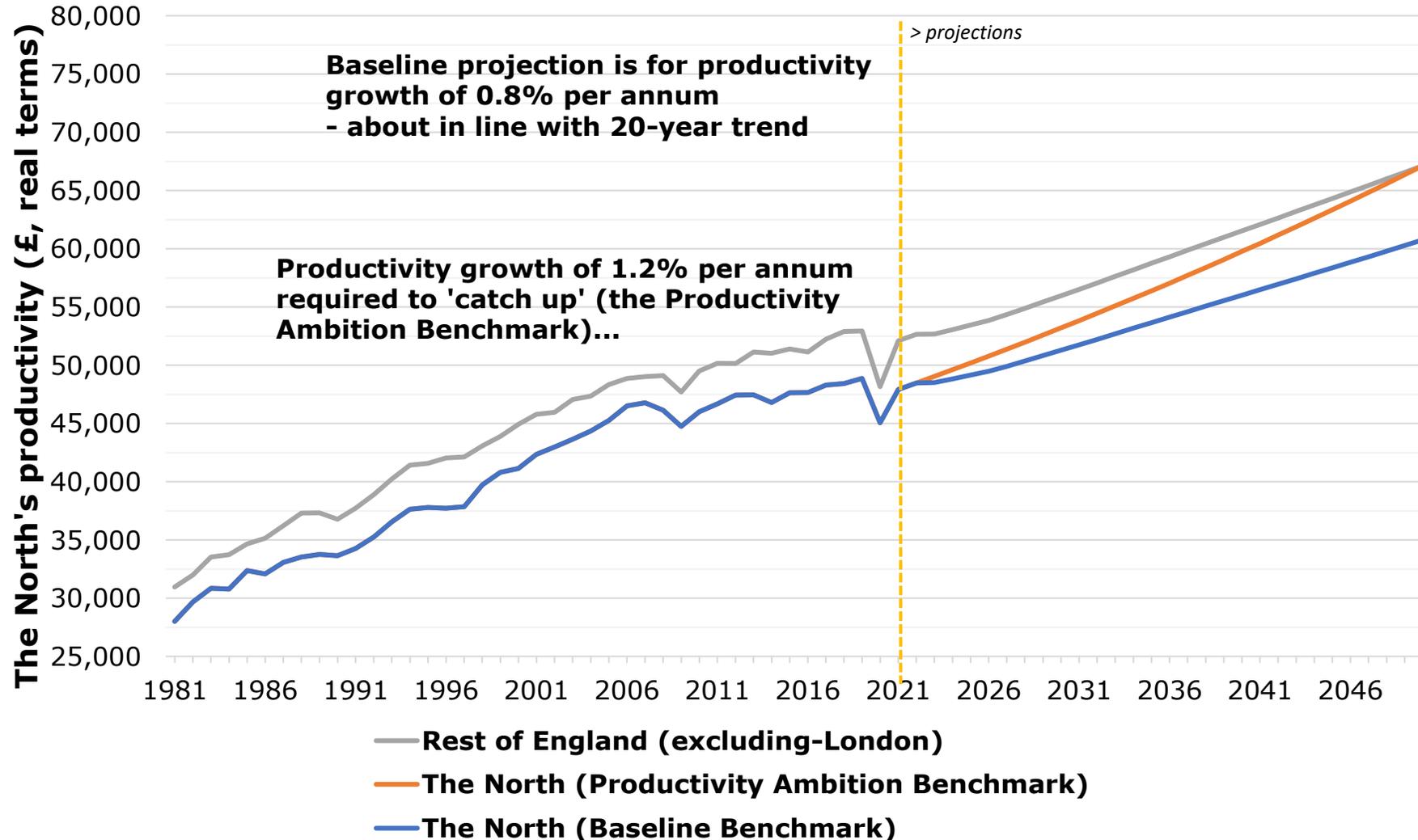


- Labour market outlook much more positive than in 2016
- Cambridge Econometrics' '22 baseline within distance of NPIER's and Oxford Economics transformational
- NPIER and Oxford Economics BAU, with hindsight, appear subdued
- Why the change in outlook? Labour market continues to prove doubters wrong
- Expected to remain highly flexible (esp. in terms of people moving into work)
- Post-Covid/Brexit prospects better for labour-intensive industries

Source: various (Cambridge Econometrics, Oxford Economics, Northern Powerhouse IER)

Note: projections have been indexed to 2015 to allow comparison across different sources, timeframes etc.

The Productivity Ambition – Closing the Gap



Headline Messages and Next Steps

Headline Messages:

- Refreshed NPIER will reset the 2050 outcomes, but the ambition remains about closing the productivity gap.
- Will use outputs as basis to agree the appropriate level of ambition in the STP.

Future Activity:

- Agree the conclusions from the evidence with LEPS and pan-Northern groups.
- Advise TfN Board in December on the implications for the STP.
- Wider conversation with Northern Partners early 2023 about broader implications and solutions emerging from this work.

Meeting:	Transport for the North Board Chief Executive Consultation Call
Subject:	Strategic Transport Plan Development
Author:	Lucy Jacques, Acting Head of Policy and Strategy
Sponsor:	Tim Foster, Interim Strategy and Programme Director
Meeting Date:	Wednesday 14 December 2022

1. Purpose of the Report:

- 1.1 To agree the overarching narrative and key messages for the second Strategic Transport Plan (STP2).

2. Recommendations

- 2.1 It is recommended that the Board:

- a) Endorse the proposed overarching narrative for STP2 set out in Section 4
- b) Agree the proposed key priorities and messages set out in Section 5
- c) Note the next steps set out in Section 6

3. Context

- 3.1 TfN has a statutory duty to produce a Strategic Transport Plan on behalf of the North of England. The first Strategic Transport Plan was adopted by the TfN Board in Feb 2019. In September 2021, the TfN Board agreed that TfN should commence work on a new programme of work to revise and update the Strategic Transport Plan (STP2) and seek adoption of the new plan no later than Spring 2024. Subsequent papers to the Board in March 2022 and June 2022 have agreed the overall structure and approach to STP2.
- 3.2 The executive continues to work closely with partner authorities to ensure that the next STP matches the vision and ambition of the original plan, but also incorporates the very significant work undertaken by TfN since 2019. In addition, the review presents the opportunity to recognise the new context and challenges facing the transport network since the pandemic. A series of positions on key issues have been developed over the last two years and agreed with the Board, including:
- a) The TfN Decarbonisation, Freight and Socially Inclusive Transport Strategies.
 - b) Policy positions covering topics including international connectivity, rural mobility and spatial planning
 - c) TfN Board positions on critical infrastructure requirements such as Northern Powerhouse Rail and HS2.
- 3.3 The final elements of the evidence base, including the Independent Economic Review, are being finalised and the intention is to publish all of the agreed evidence base alongside the draft plan in the Spring of 2023. We will also work with partners and stakeholders to enhance the evidence base with supporting information and relevant case studies to bring the STP to life.
- 3.4 The draft Strategic Transport Plan will be presented for sign-off at the TfN Board in March 2023. A statutory consultation will then follow in the summer of 2023, with a post-consultation version of the STP presented to Board for adoption in December 2023. An independent sustainability assessment (ISA) is also being prepared and will be published alongside the consultation version of the STP.

3.5 The purpose of this paper is to agree the overarching narrative, key priorities and messages so as to enable officers to complete the draft STP and engage with partners, Scrutiny Committee and the TfN Partnership Board in advance of the March Board meeting.

4. Overarching Narrative

4.1 Building on TfN's extensive evidence base and technical work an overarching narrative for STP2 starts to emerge based on:

- Restating that unlocking the economic potential of the North should continue to be a priority for the UK
- Investment to improve connectivity is fundamental to realising the North's economic potential, reducing social exclusion, and improving quality of life
- Transformation of the strategic connectivity between the North's cities and towns through the full Northern Powerhouse Rail proposal must be complemented by investment in integrated local transport solutions

This will require the North and its partners to:

- Move at pace to deliver the investment in infrastructure and services that improves connectivity, particularly so as to meet the requirement to achieve net-zero carbon
- Harness the opportunities available in a post-pandemic world to change the way we plan for, develop, and deliver transport infrastructure and services
- Work to align investment in transport with other strategic infrastructure investment to achieve the North's ambition

4.2 The cost effective and timely implementation of the framework set out in STP2 will require:

- The simplification of funding streams, thereby removing cost and inertia from the delivery of investment
- Greater flexibility in the application of the funding available, to ensure that it is targeted towards the delivery of outcomes that are place-based and user-centred
- An increase in the total investment made in the North's infrastructure and services

And this will be facilitated by:

- Providing a five-year indicative funding envelope within which statutory advice on infrastructure and service priorities is prepared
- Adopting a programme approach to the delivery of agreed strategic priorities within that funding envelope
- Working with the private sector to maximise the leverage achievable through public sector investment

4.3 This overarching narrative will continue to evolve as the detail of the STP2 is prepared. However, it will be helpful to TfN and its partners in the short term in making the case for the North following the recent Autumn Statement.

5. STP Structure and Key Messages

5.1 The Board has previously agreed a revised structure for STP2, built around four key elements:

- a) **The Case** - Setting out the Case for Change in terms of the economic, environmental and social challenges/opportunities for the North.
- b) **The Vision** - Setting a clear and ambitious 30-year vision, supported by strategic objectives and metrics

- c) **Policy and Place** – Including a “Policy for Places Framework” that enables the strategic vision and objectives to be applied to the North’s communities
- d) **The Impact** - Measuring the impact of the STP2 and setting out how TfN will work with government, local transport authorities and the industry to deliver the North’s vision.

5.2 The **case for change** will build on the original STP, retaining the original vision and scope of the previous version, but incorporating the significant change in context since 2019, the new evidence on inclusive growth and decarbonisation from TfN and the challenges and opportunities emerging from the refresh of the Northern Powerhouse Independent Economic Review (NPIER). The key messages in this section will cover:

- a) The opportunity and challenges to transform the North of England’s economy and society, building on the output from the NPIER and demonstrating the economic, social and environmental benefits to the North, the wider benefits of reducing regional inequality and why an economically stronger North benefits the UK.
- b) Set out why, given the North’s economic and social geography, improved connectivity is essential for realising that vision. Whilst transport investment can be a catalyst for change, it is not sufficient alone and alignment with investment in other areas of public policy is needed including skills, housing and place making.
- c) The case for change will be clear about the scale of challenge we face to improve connectivity across five key areas of transport (with strongest focus for TfN on improving connectivity between places and key economic assets), and why the current system is holding back investment.
- d) The importance of the North’s road network (reflecting the continued importance of the network to communities across the North but with an emphasis on the need to choose how the space available is used in order to meet needs to decarbonise, maintain access for freight and encourage active travel)
- e) The critical role of the rail network in transforming the overall transport system (recognising the need to move beyond the current crisis and take clear steps to create capacity for passenger and freight growth over a sustained period of investment)
- f) The need to invest in improving local connectivity (majoring on how this helps address the extent to which our current transport system too often acts as a barrier, how this represents an opportunity to decarbonise transport but highlighting the challenges facing LTAs in terms of funding)
- g) The importance of investing in access to international connectivity (with our ports and airports as key economic assets)
- h) The need to align investment across our transport system to achieve an integrated, affordable and connected offering (building on TfN’s work on integrated ticketing programme and smart mobility).

The case for change will use TfN’s Future Travel Scenarios (which informed the regional Decarbonisation Strategy) as the basis for planning and preparing for growth in public transport (particularly rail growth).

5.3 The TfN Board has previously agreed that STP2 will have a single vision for the North’s transport network, supported by three strategic ambitions. The Partnership Board reviewed the **draft vision and objectives** in September, following which we have finalised the draft vision as:

In 2050 the North of England will have become a thriving, socially inclusive region. Our communities, businesses and places will all benefit from

sustainable economic growth, improved wellbeing, and access to opportunities for all. This will be achieved through a transformed zero emission, integrated, safe and sustainable transport system, that will enhance connectivity, resilience, and journey times for all users.

And the three strategic ambitions are proposed as:

- a) Rapid decarbonisation of the transport network by 2045 (as agreed in the TfN Decarbonisation Strategy adopted by the Board in November 2021);
- b) Significantly reducing transport related social exclusion (defined in the Inclusive Transport Strategy agreed by the TfN Board in September); and
- c) Transforming economic performance (as defined by the Northern Powerhouse Independent Economic Review set out in the item in the paper).

5.4 The vision and strategic ambitions for the North will be underpinned by a clear set of outcome measures and supporting metrics that will, collectively, guide TfN and partner activities in its implementation. As previously agreed with the Board, the inclusion of clearly defined metrics underpinned by a robust monitoring and evaluation strategy and clear “golden thread” between activities and outcomes represents a major step forward from the previous STP, including:

- a) Including a “right share” metric that will support efforts to reduce car dependency and create the capacity required to accommodate growth on our public transport networks;
- b) Explicitly recognise the scale of change required in accessibility required to unlock opportunity and reduce social exclusion;
- c) Put in place a long-term ambition to double the share of freight carried by rail.
- d) Adopting the “vision zero” approach to eliminating deaths on our major road network by 2050.

Interim milestones for key metrics will identify what progress is required over the next 10 years to deliver on the longer-term outcomes. And because TfN is able to consider the transport system, economy and environment as a single system, we will demonstrate the synergies, trade-offs and challenges across a single system.

5.5 A full set of proposed metrics is attached at Appendix 2. There will be limited opportunity to refine the definitions further after the December Board without causing a delay in the overall STP. Calibration of target levels is currently being finalised with partners’ officers and we intend to discuss with the TfN Partnership Board in early 2023.

5.6 The **Policy and Place framework** has been developed to provide a more robust and transparent demonstration of what needs to be true to achieve the outcomes in STP2 across the different geographies of the North. It builds on TfN’s existing work on economic and social geography to present nine place typologies, developed through a series of workshops with partner officers. This innovative approach is how we will ensure the high-level vision and objectives of the plan translates into meaningful outcomes and policies for all parts of the North’s economy and society. In addition, this section of the STP will also set out:

- a) What connectivity is required between places in the North and between the North and the rest of the UK to deliver the outcomes and objectives of the plan, including the key road, rail and freight connections within TfN’s Strategic Development Corridors
- b) Recognise the critical challenges facing the transport network and set out a realistic pathway forward through the next 10 years so we are on track for the long term.
- c) Why building NPR and HS2 in full remains central to achieving the required transformation in strategic connectivity for the North.

- d) The critical need to invest in improved local connectivity and to accelerate devolution in order to enable proper integration of local public transport networks.
 - e) The importance of adopting a “whole journey” approach to affordability of travel and mobility.
- 5.7 As previously agreed with the Board, the STP will not revisit the TfN investment programme published in 2019. There will be a need to review the investment programme against the revised objectives of the STP as part of business planning for 2023/24. At the same time it will be important to identify the immediate strategic road and rail priorities for the next two 5-year funding periods for Network Rail and National Highways.
- 5.8 Finally the **Impact** section will set out how TfN will work with Government, the wider transport industry, infrastructure owners and delivery bodies, and partner authorities to implement STP2. The impact section is proposed to cover five key areas where TfN can have most impact, including:
- a) TfN’s role in supporting and enabling delivery both as a statutory body and through its formal role with the Rail North Partnership and as co-sponsor of NPR.
 - b) How TfN can act as a centre of excellence in strategic transport planning for LTAs, building on the industry leading analytical capability held within TfN and wider expertise in transport planning and business case development.
 - c) An updated assessment of the overall level of the funding required (across multiple Parliaments) and the benefits of a long-term multi-modal investment pipeline.
 - d) Embedding the principles of the Northern Transport Charter, including the need for further devolution of funding and decision making and outlining the need to embed passenger experience within our work including the citizens’ panel currently being established.
 - e) Monitoring and evaluation of progress. How we will monitor and report progress (for example on decarbonisation) against the STP vision and objectives through an annual report and action plan, which is also the opportunity to formalise and strengthen the Board’s statutory advice to Government and maintaining a focus delivery.

6. Next steps

- 6.1 The Board’s endorsement of the key principles, and messages at this stage now will enable officers to finalise the first draft of STP2 in early 2023.
- 6.2 Alongside the draft of the STP, officers are also working with Arup on the Integrated Sustainability Appraisal that will accompany the STP when published for the consultation. The conclusions of the ISA will be available for the Board meeting in March.
- 6.3 Subsequent to this Board’s discussion there will be an extensive period of engagement with partner officers, LEPs and with the TfN Partnership Board before the Board considers the final draft at its meeting in March 2023. This process will inform both the finalising of the draft itself and gather the contextual case studies and other illustrative information to help bring the STP to life.
- 6.4 Early planning is underway for a statutory consultation process to be undertaken in the summer of 2023, which will follow the local elections planned in early May. Alongside the draft STP and conclusions from the ISA, we will be seeking agreement to both the communications strategy and plans for the consultation.

7.0 Corporate Considerations

Financial Implications

7.1 No direct financial implications of these recommendations.

Resource Implications

7.2 The necessary resources to prepare the STP2 to the timeline set-out in this report have been identified and agreed, aligned to TfN's Budget & Business Planning Process for FY2022/23.

Legal Implications

7.3 The statutory obligations on TfN under the Local Transport Act 2008 as amended by Cities and Local Government Devolution Act 2016 in preparation of the STP will be kept under review to ensure the STP is legally sound and complies with the legal requirements.

Risk Management and Key Issues

7.4 This paper does not require a risk assessment. TfN's Corporate Risk Register includes risks associated with STP2.

Environmental Implications

7.5 A full Integrated Sustainability Appraisal (ISA) is being prepared to accompany the preparation of the STP2, supported by external expertise. The ISA2 Report will be consulted upon alongside the draft STP2 during 2023.

Equality and Diversity

7.6 To accompany the revised STP we will also be undertaking an Equality Impact Assessment as part of the wider Integrated Sustainability Appraisal (ISA).

TfN's Transport Related Social Exclusion workstream will allow TfN and its partners to better understand the distribution and causes of TRSE in the North and will form an important part of the evidence base for the revised STP.

Consultations

7.7 A consultation is not required at this time; the statutory consultation planned for the revised STP in Summer 2023 will be undertaken in due course.

8.0 Appendices

8.1 Appendix 1 – STP vision, strategic ambitions and SMART objectives

Glossary of terms, abbreviations and acronyms used (*if applicable*)

Please include any technical abbreviations and acronyms used in the report in this section. (Please see examples below.) This will provide an easy reference point for the reader for any abbreviations and acronyms that are used in the report.

- | | |
|----------|---|
| a) ISA | Independent Sustainability Appraisal |
| b) NPIER | Northern Powerhouse Independent Economic Review |
| c) STP2 | Second Strategic Transport Plan |

STP2 Vision, Strategic Ambitions & SMART Objectives

December 2022



Introduction

This document sets out the proposed vision, objectives and metrics for the second statutory Strategic Transport Plan (STP) for the North of England being developed by Transport for the North. The first STP was adopted in February 2019 and represented a ground-breaking 30-year vision for how a more inter-connected and productive North could deliver clear economic benefits to the residents and businesses of the North (as well as to the UK as a whole) by 2050.

TfN is now in the process of producing a revised STP ready for public consultation during 2023, including reviewing and updating the evidence in light of the pandemic and other changes seen since 2019. Once agreed, this document will form part of the under-pinning evidence base and be published alongside the draft STP as supporting documentation.

Background

Transport for the North was established in clear recognition of the opportunity to create a more prosperous and productive North that builds on its economic strengths and assets of the North and creating a more strengthened, more coherent and inter-connected economy.

Bringing its cities and other economic centres closer together can help unify the economy of the North. This reduces barriers to trade for businesses and expands job opportunities for people. This can help the region gain a size and scale of economic activity that can rival some of the largest and most productive places in the world and can ensure that the whole region is greater than the sum of its parts.

Transport is key to creating a more unified Northern economy, in terms of connectivity (journey times), capacity, and reliability. In considering possible transport interventions, we need to recognise the full range of impacts on productivity, which include:

- Reducing costs: faster or more reliable journeys (for both people and freight) can save individuals and businesses time and money.
- Agglomeration: through reducing journey times and tackling congestion improvements, transport infrastructure can bring areas closer together. This helps to concentrate economic activity and realise the benefits of greater sharing, matching and learning between workers, firms and consumers.
- Removing physical barriers to innovation and clustering: improving linkages between cities and towns that may be physically separated by long distances or by natural geographical barriers (such as the Pennines) can help foster trade and increase competition amongst businesses.
- Connectivity to international gateways: in a globalised economy, connectivity to key international ports and airports is also an important factor in attracting greater inward investment and allowing businesses in the North to find new markets and more easily trade with the rest of the world.
- Expanding labour markets: transport infrastructure can deepen labour pools by increasing the number of workers that can access higher productivity

locations more easily. The limited reach of labour markets means that Northern workers have fewer job opportunities, and Northern employers have much smaller labour markets. This is holding back wages and productivity and makes the North a less attractive place for businesses.

- Making places more attractive to businesses and people: businesses are attracted to locations with higher quality transport infrastructure particularly if they provide greater access to a higher skilled workforce, access to suppliers, customers and international gateways.

The Northern Powerhouse Independent Economic Review (NPIER), published in 2016, defined the scale of the opportunity from a more productive, higher skilled and better-connected North. The NPIER provides both the strategic rationale for investing in northern transport infrastructure, as well as an analytical framework for assessing the impact of economic transformation. The NPIER is currently being updated and will provide the underpinning evidence base for resetting the economic ambition within the second STP.

The connectivity opportunity

In the North of England poor rail and highway connectivity and public transport provision has led to unreliable journey times that restrict trade and business interactions, and reduce labour market efficiency. These barriers limit clustering of businesses and their associated agglomeration benefits, impact on productivity levels, constrain labour markets and prevent people from accessing a wider range of jobs and services. Further substantial investment is needed to provide improved connectivity and to maintain existing levels of service. Failure to invest would cost the country billions of pounds in lost economic growth, whilst increasing the cost of congestion, overcrowding and delays.

Although significant interventions are already underway or planned (e.g. the Trans-Pennine Route Upgrade and A66 dualling) further substantial improvements are needed to deliver a modern and robust transport system, capable of underpinning Government and the North's ambitions for reducing the significant economic disparities between UK regions through sustainable economic growth.

TfN's Future Travel Scenarios project robust growth in number of trips taken by rail across a range of futures, ranging from 78% to 193%. Whilst rail would only serve a small proportion of all journeys, all the scenarios project a significant market share for longer distance journeys. This demonstrates the need to take a long-term view and expand and improve the public transport offer to serve this potential market. Indeed, the North has seen a strong recovery in the rail market since the lifting of lockdown restrictions and some areas of the market such as leisure are now above pandemic levels.

Achieving the required scale of change, whilst maintaining a resolute focus on reducing transport-related carbon emissions requires a tripartite approach encompassing investment in infrastructure (maintenance, renewal and enhancements), adoption of new technologies and changes in travel behaviour. This will result in reliable, affordable, safe and user centric transport options,

including for many journeys achieving significant modal shift away from private car to more sustained modes.

Delivering transformational, inclusive economic growth requires complementary and supporting investment at a local as well as a pan-Northern level to ensure a 'whole journey' and 'total network' approach to improving transport. The start and finish of almost all journeys lies beyond the strategic transport networks and requires integration with local road networks and other modes such as local public transport, walking and cycling, and the use of the local road network.

It is imperative that we also consider the whole transport 'ecosystem'. A whole systems approach is critical to achieving environmental and social inclusivity goals whilst supporting improved economic productivity and delivering a good level of service for all transport modes. Maximising the benefits of improved road, rail and public transport investment can only be achieved through implementation of complementary policy measures. This could, for example, include encompassing spatial planning, mobility pricing, integrated public transport ticketing and so on under a single policy framework.

Developing the Vision & Objectives

As part of our preparation for producing our second strategic transport plan, in July 2022 we consulted with the TfN partnership on the relevance of the original vision and objectives of the first STP and the principles for designing the next STP. Through those discussions, we have derived three guiding principles for developing this document:

- The need to reflect the significant change in context since 2019, including the pandemic, the Levelling up agenda and funding and delivery challenges now facing the industry.
- The importance of a clear flexible framework, able to reflect the current uncertainty around travel behaviours following the pandemic, but also able to reflect the long-term transformational ambition of the North.
- The need to create a triple bottom line: the economy; the environment; and inclusivity, thereby ensuring that the TfN STP remains relevant outcome focused.

As a result of this TfN will apply the following Strategy hierarchy for our second Strategic Transport Plan (STP2).



This document focuses on the first four elements of our strategy hierarchy (identified in blue), the final two elements (identified in purple) will continue to be developed as part of our Monitoring and Evaluation Strategy. This document is included for reference in draft form in Annex 2 and will be presented back to TfN Board in March 2023.

The Vision and Strategic Objectives

Our vision has been amended to better reflect our net zero commitments, our commitment to social inclusion and our aspirations for the North's transport system. Our proposed vision for STP2 is now:

By 2050 the North of England will have become a thriving, socially inclusive region. Our communities, businesses and places will all benefit from sustainable economic growth, improved wellbeing and access to opportunities for all. This will be achieved through a transformed zero emission, integrated, safe and sustainable transport system, that will enhance connectivity, resilience and journey times for all users.

The Northern Transport Charter sets out the long-term principles for how this can be achieved, embedding the required activity within a Northern Appraisal Framework for decision making on investment priorities. Such an approach complements earlier work on Investment Programme prioritisation undertaken as part of our Strategic Development Corridor qualitative sequencing. The STP will set out more of the detail for how we will assess our investment programme against the strategic ambitions agreed in the plan.

The strategic ambitions identified are:

- **Transforming economic performance** – as set out in the Northern Powerhouse Independent Economic Review (NPIER).
- **Rapid decarbonisation of surface transport** – as set out in TfN's Decarbonisation Strategy.
- **Reducing Transport Related Social Exclusion** – as set out in TfN's Socially Inclusive Transport Strategy; and

Northern leaders have been resolute in their commitment to addressing these systematic issues by committing through TfN Board a number of stretching targets that go further and faster than current national government policy. The scale of ambition under each of our strategic ambitions is clearly articulated in the relative report but summarised below.

- To address the historic productivity gap between the North and the South – as set out in the NPIER – by 2050.
- To achieve near zero emissions from surface transport by 2045 – as set out in TfN's Decarbonisation Strategy; and
- To lower the proportion of population at risk of Transport Related social exclusion to the England average (excluding London) – as set out in the Socially Inclusive Transport Strategy.

For each ambition there are a number of sub-themes which together represent relevant aspects of the objective and an overview of the best current available metrics; this will allow appropriate analysis, monitoring and evaluation of performance.

As TfN's draft Monitoring and Evaluation Strategy states, none of the STP objectives exist in isolation and there are complex synergies and trade-offs that can only be understood by examining them in combination.

The metrics proposed are already a fundamental part of the TfN analytical framework and builds on work undertaken in a range of TfN workstreams including the Northern Powerhouse Rail business case, the development of the TfN Economic Recovery Plan in 2020 and the sequencing and appraisal of the TfN Investment Programme. In enshrining these metrics as agreed Northern targets and trajectories within our statutory plan, this will now sharpen TfN's focus on the need for sustained progress on our shared objectives, whilst recognising the necessary trade-offs in doing so.

We recognise that, over time, the strategic ambitions themselves will be influenced by wider external factors and will also need to respond to emerging Government and local partner priorities. So, in addition to setting clear targets for 2050, TfN will:

- Like in TfN's Decarbonisation Strategy, set interim targets to 2030 to reflect the pace of change needed over the next few years;
- Regularly monitor progress on as part of the implementation of the STP through an annual Action Plan; and
- Review and recalibrate our long-term strategic ambitions and underpinning metrics.

Transforming Economic Performance

Rationale for Strategic Ambition

The North is home to around 1.1 million businesses¹, and prior to the impact of Covid-19 employed around 7.35 million people². **The region is currently home to over 15.6 million people³, with population growth of 9%⁴ from 1999 to 2020.** The North's economic gross value added (GVA) is around £368 billion, c.19% of UK total⁵.

However, overall productivity in the North trails behind that of the rest of England. Since 1981, the North's economic value per person (measured as GVA) has been typically 10-15% below the average for the rest of the England, excluding London⁶. And the most recent available data reveals that gap is 10.6% below the rest of England average, excluding London⁷. Proactively taking action to tackle the causes of weak productivity growth in the North, and to close this gap in GVA per capita, represents an economic opportunity for the North that would also contribute to the success of the UK in the global marketplace. And the success of the Government's Levelling Up agenda depends upon transforming the economy of the North.

The scale of this economic opportunity for the North was first set out in the Northern Powerhouse Independent Economic Review (NPIER 2016), which set out a bold vision of economic transformation for the North that would support rebalancing of the UK economy and increase international competitiveness. The NPIER considered the scale and causes of the North's persistent and widely recognised 'performance gap', especially the factors driving relatively low productivity (underperformance in enterprise formation, workforce skills, innovation and technology, investment and agglomeration). It also considered the North's competitive advantages and sector strengths, identifying a series of key 'prime' and 'enabling' capabilities within the North.

Since the 2016 NPIER, there have been substantial changes in the policy and economic context, including the political and economic consequences of Brexit; the growing policy salience of decarbonisation; the economic shock caused by the Covid-19 pandemic; as well as evolution in the local economic development

¹ Business Population Estimates 2021, October 2021, BEIS [Accessible [here](#)]

² Labour Force Survey (Jan-Mar 2020), July 2022, ONS [Accessible [here](#)]. The most recent data (Mar-May 2022) indicates that the number of people in employment across the North is around 7.25 million.

³ Office for National Statistics (2021), '*Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland: Mid-2020: 2020 local authority boundaries*'. [Accessible [here](#)]

⁴ The North's population was estimated to be around 14.28 million in 1999, compared to a 2020 estimate of 15.57 million. Office for National Statistics (2021), '*Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland: Mid-1991 to Mid-2000*', [Accessible [here](#)]

⁵ Office for National Statistics (2021), '*Regional Gross Value Added (balanced) by industry: all ITL regions*' [Accessible [here](#)]

⁶ The Northern Powerhouse Independent Economic Review: Final Executive Summary Report, June 2016, Cambridge Econometrics and SQW [Accessible [here](#)]

⁷ Regional gross value added (balanced) per head and income components, May 2021, ONS [Accessible [here](#)]

architecture and the economic development funding landscape. The period since 2016 has also seen persistently weak productivity growth in the UK, alongside a widening gap between the North and the rest of the country.

Against this backdrop, in 2022/23 TfN, NP11 and Northern partners are refreshing the NPIER to develop a new economic vision for the North, supported by a broader set of economic scenarios to aid decision making, to inform the revised STP and stakeholders' economic development policies and strategies⁸.

While addressing the North's productivity gap will remain a focus of the NPIER economic vision, policy makers are now keen for other, broader aims to also be considered as part of a vision for the North, including aspects such as inequality, the environment, health and wellbeing and sustainability.

The emerging framework for a new set of scenarios will include a number of 'change scenarios', each representing a different basket of policy levers or ambitions which could contribute to productivity growth, testing out the extent to which they may contribute to the North's economic and wider ambitions. Each 'change scenario' will be assessed against a range of economic, environmental, and social metrics to understand its performance against different policy objectives, and where potential trade-offs may lie. To provide additional context, these will be supported by three 'benchmark scenarios' representing a baseline/business-as-usual scenario, a 'closing the productivity gap' scenario and a 'matching the UK average level of public investment' scenario, with the two latter scenarios demonstrating the scale of the gap, and the notional prize if the gap could be bridged.

The revised STP will explore how transport improvements can support each of the different 'change scenarios' or routes to productivity growth by creating synergies and maximising the impact of complementary policy interventions which may focus on low carbon technologies, skills improvements, or increasing development supply. The role of transport in connecting people, places, businesses and goods, supporting agglomeration and clustering, and providing access to economic and social opportunities will remain central to this.

Components of Strategic Ambition

Closing the North's productivity gap: As a key driver of long-term economic performance, prosperity, and living standards, productivity growth remains a focus of the refreshed NPIER and STP. However, there is a recognition that a narrow focus on growth in productivity or economic output, without consideration of its environmental or social impacts, is no longer appropriate.

Supporting sustainable and inclusive economic growth: Focusing on economic interventions and policies which contribute to the net zero transition, reduce inequality, and improve social inclusion (such as capitalising on the North's strengths in the 'green economy').

⁸ In May 2022, TfN commissioned Cambridge Econometrics, working in partnership with the consultancy SQW, to undertake the development of a series of economic scenarios that will be modelled to 2050 and refresh the NPIER. The commission is due to conclude in December 2022.

Connecting people, businesses and goods: Transport remains a key enabler for a prosperous and inclusive North, connecting individuals to economic and social opportunities, stimulating business interactions, and ensuring that goods needed by individuals and businesses can be moved around effectively.

Headline objectives

STP impact	Metric	Reporting
Improved economic productivity	Close the productivity gap between the North and the average for the rest of England excluding London by 2050	Annually
Integrating the North's labour market	37% of the North's population can access 500,000 jobs within 60 minutes by rail by 2050, up from 27% in 2018	Every 5 years
Integrating the North's labour market	75% of the North's population can access an employment centre with at least 5,000 jobs by public transport within 30 minutes by 2050	Every 5 years
Improved journey time reliability of the road network	Reduce the proportion of the Major Road Network experiencing excessively unreliable journey times during weekday peak times to 2050	Every 3 years
Improved journey time reliability of the road network	Reduce the proportion of the Major Road Network experiencing excessively unreliable journey times during the weekend to 2050	Every 3 years

Trade Offs

Enabling long term economic growth & "Levelling Up": The UK overall has benefited from the evolution of its economy and a period of globalisation, but these benefits have not been realised equitably across all areas and communities in the UK, and large disparities exist. Some of the UK's most successful cities are home to a number of the worst areas of deprivation to be found in the country. And the North of England is home to the top five most deprived local authority areas in England⁹. Public sector investments, like private, favour those perceived to have the greatest return. This has led some areas to fall behind as they are now underinvested and have weaker growth opportunities. Levelling up seeks to

⁹ Middlesbrough, Liverpool, Knowsley, Kingston upon Hull and Manchester. The English Indices of Deprivation (IoD2019), available at [The English Indices of Deprivation 2019 \(publishing.service.gov.uk\)](https://publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/101422/the-english-indices-of-deprivation-2019.pdf), last accessed 28th July 2022.

address this challenge, trading off short term gain for the longer-term prosperity for all.

Agglomeration vs Levelling Up: Major transport schemes have relied on demonstrating agglomeration benefits, bringing together areas of economic activity and improving access to a wider labour market. Post-pandemic changes to work and the need to Level Up create a tension with agglomeration. The potential to work more locally and the need to achieve Levelling Up, will require more locally focused transport schemes to help distribute growth.

Economic Growth vs Decarbonisation:

The case for decarbonising the economy to limit further human-impact the Earth's climate has been well made. However, addressing the challenge requires changes to demand, investment and costs. Whilst in the long term these changes will be positive for the economy, not least as they will reduce the cost of climate-related catastrophes, in the short term there will be disruption to the economy as it restructures and there will be the burden of cost on both private and public purse.

For the North, the NPIER 2016 highlighted the energy and advanced manufacturing sectors as prime capabilities for the region, demonstrating that there is a potential benefit to the North of decarbonisation. However, on the negative side, large parts of the North's remain carbon-intensive or reliant on its use, e.g., refining oil. As such, in the short – medium term achieving higher levels of economic growth in the North might have a negative impact on the environment and be misaligned to TfN's commitments in our decarbonisation strategy, unless there is active support for those sectors that can address the challenge.

Service levels vs economic viability: Increasing service levels to deliver a more inclusive network may lead to a higher cost per passenger and may be at the expense of investment elsewhere on the network.

Rapid Decarbonisation of Transport

Rationale for Strategic Ambition

In the UK, transport is the largest contributing sector to greenhouse gas emissions, accounting for 22% of all emissions in 2019¹⁰, of which more than 95% are from road transport. Furthermore, transport emissions have actually grown overall since 2013, despite modest falls in the last few years¹¹.

Drops in emissions during 2020 due to reduced levels of travel during the COVID-19 lockdown, are likely to be temporary, with demand for car travel rebounding more quickly than public transport, approaching pre-pandemic levels.

¹⁰ This relates to surface transport and does not include emissions from aviation and shipping.

¹¹ <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019>

TfN and our partners believe that an acceleration towards a zero-carbon transport network must be at the heart of public policy making and investment decisions. Our ambition for the North is to travel faster and further than national policy and maximise the clean growth opportunities that decarbonisation can provide for the North. Through our Decarbonisation Strategy, TfN and our partners have committed to a regional near-zero carbon surface transport network by 2045.

As important as the end date, are our interim milestones along our trajectory, including a 56% reduction in emissions by 2030 and a 96% reduction by 2040. If as a region, we can achieve these reductions by these milestones, it will mean we've restricted the cumulative transport emissions produced in the lead up to the near zero date – living within the total carbon budget identified within our Decarbonisation Strategy.

Engagement with both our partners and the public during the development of our Decarbonisation Strategy indicated that the provision of real modal choice through the development of a world class, reliable, flexible and cost-efficient public transport system, needed to be at heart of the North's transport decarbonisation journey.

One response to this challenge has been TfN's Clean Mobility Visions, developed using evidenced based policy packages, demonstrating the benefits of reduced car usage both in terms of carbon reduction, but also in tackling issues such as local air quality, Transport Related Social Exclusion and boosting local economic growth. As an organisation, we operate at a geographical and institutional level that allows us to both understand what works best for our different places in the North, and to communicate this to Government to ensure that tools such as the Clean Mobility Vision framework, are in place to support the capability of our Partners to incorporate national decarbonisation objectives within their local policy making in the most effective ways.

TfN can also facilitate regional approaches to decarbonisation measures and research where it's needed, for example, developing a pan-regional electric vehicle charging infrastructure framework, identifying en-route charging locations between our different places, recognising that travel often crosses administrative boundary. As well as 'cross-boundary', TfN is also able to work effectively across sectors with organisations which operate at a similar regional scale, for example research with our universities and Gas Distribution Network Operators around hydrogen refuelling locations for heavy duty transport in the North . Indeed, a high proportion of the emissions from private road vehicles is generated by longer distance regional-level trips, with our analysis indicating that around 70% of road transport emissions in the North originate from trips on the Major and Strategic Road Networks. This means TfN has both an opportunity and a responsibility to help reduce this significant share of road transport emissions.

Components of Strategic Ambition

Reducing Carbon. Supporting the agreed TfN decarbonisation trajectory requiring the North to bring all greenhouse gas emissions from surface transport to close to zero by 2045 and ensuring TfN’s Decarbonisation Strategy and the actions contained within it are achieved. TfN will also continue to explore how to effectively consider embodied carbon within our investment programme.

A Fair Transition. Major changes are going to be needed in terms of our physical transport systems but also in our travel choices. It’s important that opportunities that this transition presents for reducing existing inequalities in health, wellbeing and accessibility are not passed up – and indeed that new distributional impacts are not created.

Health and well-being. Contributing to improved health outcomes for people of The North but particularly those living in close proximity to TfN’s major road network and rail stations. This includes improving air quality and reducing the impact of noise created by the North’s transport network.

Nature Based Solutions. Recognising the ecological crisis alongside the climate crisis and the critical interplay between our natural environment and the climate. Many of the North’s unique habitats are at risk from the effects of climate change, whilst at the same time in the North’s natural environment will have a critical role to play in both climate change mitigation (e.g. peat restoration and reforestation schemes) and also in adapting to a changing climate through nature-based solutions that can reduce flooding and stabilize soils and reduce the need for mechanical cooling. New legislation around Biodiversity Net Gain creates an opportunity to better integrate new transport infrastructure with these solutions, supporting Local Nature Recovery Strategies.

Headline objectives

Impact	Target	Reporting
Eliminate surface transport CO2 emissions	Reduce surface transport CO2 emissions from 25 million tonnes in 2018 to near zero by 2045	Every three years
Modal shift to public transport and active travel	Share of trips made by public transport increases from 8% to 15%, and active modes from 29% to 36%, by 2045	Annually
Modal shift to public transport and active travel	Zero overall increase in travel demand on the road network by private car to 2045	Annually
Freight modal shift to rail	Double rail’s share of freight carried to 12% by 2050	Every five years

Accelerate the roll-out of EV charging points	Uptake of public EV charging points at scale and pace across the North to support TfN's regional decarbonisation trajectory to 2045, increasing to at least 123,500 by 2030 (90,000 non-rapid destination and public residential, 33,500 en-route rapid)	Annually
Reduce population exposure to air pollution from transport	Eliminate the need for Air Quality Management Areas in the North announced due to NO2 or PM10 by 2045 by bringing air quality within legal limits	Annually
Reduce population exposure to air pollution	Reduce to zero the number of paths on the North's Major Road Network that exceed WHO Nitrogen Dioxide exposure limits by 2045	Annually
Improve biodiversity around the North's transport network	All new major transport infrastructure development to aid local nature recovery by achieving 10% biodiversity net gain, for projects gaining approval from 2025 (in line with the Environment Act 2021)	Every five years

Trade Offs

Environmental Protection and Enhancement: The delivery of transport infrastructure schemes has the potential to adversely affect our natural, built and historic environments, and mitigating these impacts can substantially increase scheme costs. However, these challenges are also opportunities to enhance our wider environment, improving local air and water quality, reducing noise and responding to the new requirement to achieve Biodiversity Net Gain, thereby complementing Partners Local Nature Recovery Strategies.

Compliance with Paris Agreement and Climate Change Act & Scheme Delivery: the requirement for proposed transport infrastructure schemes to demonstrate compliance with the Paris Agreement and no significant effect on climate change is likely to delay or stop the development of schemes which have demonstrated economic and social benefits.

Additional scheme requirements for climate change adaptation, in order to future-proof schemes against climate change effects, as well as other additional environmental requirements such as biodiversity net-gain, could increase overall

scheme costs in the short term, although designing for climate change and utilising nature-based solutions are likely to reduce costly mitigation works later in the scheme's life.

Capital Costs associated with Low/Zero Emission Vehicles – purchase prices for low or zero emission vehicles and locomotives vary widely but are still substantially more expensive than internal combustion engine equivalents. In the case of public transport (e.g., train locomotives, buses), there may be a trade-off between the number of low emission vehicles that can be purchased and the rate of overall fleet renewal. It is important that this does not affect public transport service provision as it is through modal shift that the most substantial emissions reductions can be realised.

Balancing freight and passenger services: Expanding rail freight and passenger services simultaneously requires managing trade-offs between the two, particularly on constrained parts of the network.

Economic Growth vs Decarbonisation: See above under Transforming Economic performance.

Reducing Transport Related Social Exclusion

Rationale for Strategic Ambition

Transport-related social exclusion (TRSE) is the “process by which people are prevented from participating in the economic, political, and social life of the community because of reduced accessibility to opportunities, services, and social networks”.¹² This occurs where the transport options available provide limited or no access to some key destinations, and where there are significant financial, time, and wellbeing costs linked to using the transport system.

TfN's focus on TRSE is rooted in the Northern Powerhouse Independent Economic Review (NPIER). Specifically, the NPIER highlighted the barriers that populations in the north of England face in accessing employment, education and training caused by fragmented and limited transport links. Following from this, TfN's 2019 Strategic Transport Plan committed to improving “inclusivity, health, and access to opportunities for all”, and the ambition in the Northern Transport Charter is for TfN to champion “an inclusive and sustainable North”.

Following the 2019 STP, TfN has undertaken extensive research to identify the nature, causes, distribution, and extent of TRSE in the North.¹³ This research demonstrates that 3.3 million people live in areas in which there is a high risk of TRSE, and that there is a significantly greater concentration of TRSE in the North compared with the rest of England. The following factors, that are widely present in the North of England, are key to this relationship:

¹² Based on the definition developed by Kenyon et al, 2003: 210. Cited in Lucas, 2012. Available at: <https://doi.org/10.1016/j.tranpol.2012.01.013>

¹³ See TfN (2022) Transport-related social exclusion in the North of England.

- (1) Fragmented, unaffordable, and unreliable public transport services, that does not provide adequate access to key destinations for all populations and areas.
- (2) A lack of safe, convenient, and accessible walking, cycling, and wheeling infrastructure, combined with car-dominated environments.
- (3) The high levels of car dependency and forced car ownership that result from poor public transport and active travel conditions.

TfN's research demonstrates that TRSE has a fundamental impact on the everyday lives of many in the North. This includes being at higher risk of poverty and multiple deprivation, poor health, and social isolation. Across these themes, TfN's strategic ambition on TRSE is driven by the following factors:

- (1) A focus on reducing TRSE is closely linked to the reduction of inequalities between areas of England, and to economic growth. This is primarily through expanding access to good quality and secure employment opportunities for deprived communities, and through expanding access to high quality education and training opportunities for these communities.
- (2) A focus on reducing TRSE is closely linked with improved quality of life. As well as through improved access to employment and education, and the reductions in deprivation this is associated with, this will result from improvements to access to leisure, recreation, and to family and community life. These benefits occur directly, and through improved health.
- (3) A focus on TRSE is closely linked to the reduction of highly pervasive social inequalities. This includes inequalities based on income, disability, caring responsibilities, gender, and ethnicity. A growing evidence base demonstrates that transport plays a significant part in sustaining these inequalities.

Components of Strategic Ambition

Reducing car-dependency and forced car ownership: Reducing the requirement for access to a car in order to access key destinations, and through this reducing the significant financial hardship that can be associated with maintaining car access.

Improving access to key destinations by public transport and active travel: Improving the distribution of public transport infrastructure and services in areas where there is currently a high risk of TRSE. Alongside this, ensuring that transport infrastructure and information is accessible for all, and delivering a step-change in the quality and availability of active travel infrastructure.

Improving affordability and reducing transport poverty: Ensuring that the necessary levels of transport use for work, education, recreation, and family and community life are affordable for all. This includes ensuring that the costs of the necessary levels of transport use for these purposes does not compromise the ability of people to afford other essentials.

Improving safety, security, and belonging: Ensuring that all potential users are safe, secure, and welcome in transport spaces. This includes ensuring that roads provide safe and convenient routes for active travel, that those waiting for

and using public transport are not exposed to crime and anti-social behaviour, and that security approaches do not exclude any potential users.

Improving transport availability outside of peak commuter routes:

Ensuring that a sufficient and suitable level of transport provision is available outside of peak commute times and routes. This includes ensuring that cross-boundary, inter-neighbourhood, and multi-modal trips do not result in disproportionate time and financial costs.

Headline Objectives

Impact	Objective / Target	Reporting
Improve the performance of the rail network	Public Performance Measure (PPM) of at least 91.2% for both Transpennine Express and Northern by 2028, returning to levels last seen prior to 2018	Annually
Lower proportion of the populated affected by transport related social exclusion Lower proportion of the populated affected by transport related social exclusion	Eliminate the gap (currently 2.7%) between the North's population at high risk of TRSE compared to the rest of England outside of London by 2050	Every three years
	Eliminate the excess population vulnerable to TRSE due to gap with rest of England outside of London by 2050 (currently at 400,000)	Every three years
	Eliminate the gap of population at high risk of TRSE for the North's sub-regions compared to the rest of the North by 2050 (currently 10.2% or 272,000 for North East and 0.5% or 26,500 for Yorkshire and Humber)	Every three years
Improved safety of the transport network	Vision zero: reduce the number of people killed and seriously injured in traffic incidents from 7,538 (2018-19 average) to zero by 2050	Annually
Improved physical accessibility of the transport network	All stations in the North to meet TfN's desired accessibility standards by 2050 (currently at 53% of required level)	Every five years

Trade Offs

Local vs national connectivity: On a constrained rail network, there is a trade-off between local stopping services and express intercity services. With finite funding for transport schemes, there is also a need to allocate adequate

funding for both, balancing benefits for social inclusion and economic transformation. This also applies to the strategic and major road networks, where people making short local journeys can often account for a significant share of the traffic, impacting on congestion and on the reliability of longer strategic journeys.

Electric vehicle uptake: Transport decarbonisation and social inclusion are largely complementary aims, with the impacts of climate change likely to disproportionately impact deprived and social excluded communities. However, the rapid adoption of electric vehicles has the potential to increase transport-related social exclusion. This is likely to occur if and where electric car charging infrastructure is prioritised over active travel accessibility, where the falling per-mile costs of electric vehicles leads to an increase in traffic levels, and where spending on electric vehicle infrastructure is prioritised over local public transport.

Short term economic growth: Initiatives to reduce transport-related social exclusion do not necessarily align with those most likely to boost economic growth in the short term. Prioritising transport interventions for relatively wealthy rather than relatively deprived communities can, for example, provide a greater short-term economic boost than the reverse. However, mitigating the role that transport plays in social exclusion, and through this reducing social exclusion more widely, is aligned with long term and sustainable economic growth.

Car dominance and dependency: Reducing TRSE and delivering an inclusive transport system requires transformation in public transport and active travel, in order to significantly narrow the gap currently present with private car travel. In a financially constrained environment, this will inevitably require funds that would otherwise be devoted to improving conditions for private car travel to be spent on public transport and active travel. Transforming places to reduce levels of car dominance, and through this improving inclusion and reducing carbon, will also entail trade-offs with convenience for car users, even where overall levels of accessibility are improved.

Network performance vs disruption: Delivering projects and their benefits faster through Project Speed, including rail electrification, may lead to greater network disruption in the short term, as well as reduced opportunities for efficient delivery (e.g. by undertaking enhancements alongside planned renewals). This could deter passengers from the network and have a potential negative impact on modal shift at a time when we need to grow patronage on the network.

Monitoring and Evaluation Strategy

TfN's Monitoring and Evaluation Strategy is key to ensuring a continued focus on the STP Vision and Objectives following publication and adoption of STP2, covering the bottom two elements of the STP2 Strategy hierarchy.

The purpose of this strategy is to monitor the North's progress towards the collective ambitions set out in the STP. The proposed approach reflects how achieving these ambitions is a collective effort enabled by TfN and delivered by

national government, local transport authorities, delivery agencies and the private sector. These metrics are intended to compliment and inform KPIs of delivery bodies such as National Highways and Network Rail and Local Transport Plan objectives.

The Strategy has two key elements that support the STP:

- **Monitoring and Evaluation Framework:** This consists of the headline metrics detailed above, plus a series of core and supplementary metrics. To ensure transparency, TfN will publish these metrics and develop a dashboard containing them that will be made available to partners.
- **STP Annual Action Plan:** This will be an annual document consisting of a review of progress towards the STP Vision and Objectives, an overview of TfN's contribution towards these objectives over the previous year, and TfN's plans for the upcoming year as set out in the Business Plan and associated KPI's.



Transport for the North
2nd Floor
4 Piccadilly Place
Manchester
M1 3BN



Transport for the North
Ground Floor
West Gate
Grace Street
Leeds
LS1 2RP

 0161 244 0888

@ info@transportforthenorth.com



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Meeting:	Transport for the North Board Chief Executive's Consultation Call
Subject:	The Future of Rail in the North
Author:	David Hoggarth, Strategic Rail Director
Sponsor:	Martin Tugwell, Chief Executive
Meeting Date:	Wednesday 14 December 2022

1. Purpose of the Report:

- 1.1 To provide the Board with the opportunity to review current rail performance issues, consider the importance of continuing to make the case for rail, and consider the opportunities to achieve rail reform in the North.

2. Recommendations:

2.1 The Board is recommended to:

1. Stress the importance of train operators being held accountable against service recovery plans;
2. Support the development of a Rail Academy for the North which will ensure there is a pipeline of trained drivers and operational staff;
3. Restate the critical importance of delivering Northern Powerhouse Rail 'in full' in order to realise the economic potential of the North;
4. Stress the importance of the Government maintaining progress with major projects already in the pipeline, including:
 - Delivery of measures identified by the Manchester Recovery Task Force
 - Transpennine Route Upgrade (TRU)
 - HS2 Western Leg
5. Stress the importance of the Government progressing at pace with the need to:
 - Bring forward plans for a new station serving Bradford, one which makes passive provision for NPR 'in full'
 - Publish the Terms of Reference for Leeds – Sheffield study identified in the Integrated Rail Plan
6. Agree to prepare and publish the case for using the existing rail devolution in the North as the basis for rail reform; and
7. Agree to write to the Rail Minister emphasising the importance of taking into account the impact on revenues, unmet demand and wider economic and social impacts when setting the budgets for Northern and TPE.

3. Main Issues:**Background**

- 3.1 A reliable and expanding rail network in the North is essential to today's passengers and businesses. It has also been identified in the statutory Strategic Transport Plan as being essential to unlocking the North's economic potential in a way that is sustainable for the long term. Transport for the North's evidence base shows how today's network needs to be developed and expanded, building

on investment identified in the Government's Integrated Rail Plan and HS2. This includes delivery of NPR 'in full' – i.e. as originally identified by the TfN Board.

3.2 Since Covid, the North has been at the forefront of the growth back in passenger numbers – regularly outstripping growth elsewhere on the network (at the time of writing major stations in the North stood at 91% of pre-covid demand compared to London stations at 71%). Just last month, Northern reported its third highest revenue week ever indicating the strength of the market and the potential for growth in the future. The recovery of rail services in the North – and by extension revenues – is in sharp contrast to other parts of the country.

3.3 However, over the last few months the North has seen unacceptably poor levels of performance on the network with record levels of cancellations particularly on Avanti West Coast and TransPennine Express. This disruption has inconvenienced people's daily lives and routines and impacted businesses across the North. Transport for the North has calculated the impact of delays and cancellations in the North to be around £8m per week (for TPE and Northern) which equates to £0.416 billion a year. The North has been experiencing the current level of unreliability for most of 2022 in a way that would not have been accepted elsewhere in the country.

Tackling Poor Performance

3.4 There are several reasons for the current unreliability, some of which are outside the direct control of the operators, but others are down to them to fix. Rail North Committee has been kept apprised of the issues underpinning the poor performance which include a backlog of driver training following Covid (where training was stopped for a significant period), high levels of sickness which persist in some of the operators, increased numbers of drivers leaving the business and the ongoing and industrial relations issues across the industry including, but not limited to, strikes.

3.5 Rail North Committee met with representatives from the train operators (Avanti, Northern and TPE) on 15 November 2022 to hear about their recovery plans and seek assurances on behalf of the travelling public. There are many interwoven and structural issues driving the current unacceptably poor performance in the North that underline the need to reform the industry. The root cause of many of the current problems is a shortfall of fully qualified and trained drivers available following delays to training during Covid. This has been exacerbated by recent high sickness levels and the lack of overtime working agreements that have historically been used to manage shortfalls on a day-to-day basis. Operators have been recruiting drivers (TPE has more drivers than it has ever had working for the company), but training has a long lead time for a driver to become fully qualified and therefore urgent action is needed.

3.6 The Committee discussed and endorsed actions calling for:

- The train operators in the North being provided by the DfT with the flexibility to put in place short term arrangements that could bring about an immediate improvement – including Rest Day Working Agreements;
- A commitment to progress a Rail Academy for the North which will ensure there is a pipeline of trained drivers to end the reliance on overtime working;
- Operators to be held to account for their service recovery plans and commitments using all available contractual levers;
- Operators providing better information and assistance to passengers where their journeys are disrupted; and

- Devolved funding to tackle small-medium sized network hotspots (identified and prioritised by Transport for the North) that are currently impacting on performance.
- 3.7 Following the Committee meeting, the Transport for the North Chair and the Northern Metro Mayors had meetings with the new Secretary of State to set out the unacceptable impact of poor performance on the people and businesses across the North. It is understood that the North's train operators are to be given a revised mandate enabling them to explore with their unions and staff short-term working arrangements in the way Rail North Committee had set out.
- 3.8 Meanwhile the December timetable change takes place on 11th December. The Rail North Committee at its meeting on 15th November was clear that in respect of the Avanti West Coast Main Line their expectation was that this would see the restoration of the timetable in full. The Committee was also clear that if the timetable was not restored then it would look to this Board to consider what, if any, representation TfN might make to the Department on behalf of the North.
- 3.9 Through the Rail North Partnership TfN has a contractual relationship with DfT in the oversight of the delivery of TPE and Northern. Of the two the performance of TPE is the one that gives greatest cause for concern. This Board may wish to consider what, if any, representation TfN should make, through the Rail North Partnership, in respect of the performance of TPE.

Northern Powerhouse Rail

- 3.10 Delivery of Northern Powerhouse Rail 'in full', High Speed 2 (including the Eastern Leg) and the Transpennine Route Upgrade were all identified as essential infrastructure requirements in order to unlock the economic potential identified by the Northern Powerhouse Independent Economic Review.
- 3.11 The Government's plans for NPR and HS2 (as set out in the Integrated Rail Plan) do not meet the Board's agreed networks, leaving cities such as Bradford and Hull not served by NPR and no plans to improve important corridors such as Manchester to Sheffield. Current plans for HS2 envisage a network from London to Manchester and the East Midlands only. And it is currently unclear how or if Leeds would be served by HS2 or what alternatives to the now withdrawn Golborne Link are under consideration. The Integrated Rail Plan included the concept of an 'adaptive pipeline', a recognition that the proposals set out in the IRP would continue to evolve over time, and that additional investments may be justified in due course.
- 3.12 The current position on NPR, HS2 and TRU is summarised in Appendix 1. Members will recall that at the last meeting of the TfN Board it was agreed that TfN should seek reinstatement on the TRU Programme Board. Discussions with DfT and Network Rail in this regard are on-going, with all parties seeing the added benefit of strengthening the linkage with TfN.
- 3.13 As this meeting will have discussed in relation to the updated Northern Powerhouse Independent Economic Review, the economic gap between the North and South remains a deep concern. The overarching narrative for the refreshed Strategic Transport Plan will emphasise that unlocking the economic potential of the North should continue to be a priority for the UK.
- 3.14 Whilst the implications of the Autumn Statement for transport investment are being worked through it is timely for TfN to:
- Restate that the evidence shows that delivery of Northern Powerhouse Rail in full (as identified by the TfN Board) remains the key long-term transformational investment

- Stress the importance of the Government continuing to commit funds to deliver projects already in the pipeline – such works associated with the Manchester Recovery Task Force, Transpennine Route Upgrade, and HS2 Western Leg
- Stress the importance of the Government progressing at pace with the need to bring forward plans for a new station at Bradford and with publishing the Terms of Reference for the Leeds – Sheffield study

Rail Reform

- 3.15 Many of the rail issues encountered in the North stem from the fragmented way the industry is currently managed. The well documented problems in the North in May 2018 led to the Williams Review and the White Paper published by Government in 2021. This set out ambitious plans, which Transport for the North supported, for the creation of Great British Railways (GBR) to act as the guiding mind for the industry and end the fragmentation.
- 3.16 It has recently been confirmed that the legislation necessary to establish Great British Railways has been delayed. The original plan to establish Great British Railways by April 2024 is now unlikely to happen. Government is looking at elements of the plan that can be delivered without primarily legislation, but there is currently no clarity about what will be implemented and when.
- 3.17 The Rail North Committee discussed and identified a set of actions that could be taken forward in the North to progress Rail Reform without needing to wait for legislation, based on a set of principles:
1. Build on the existing devolved arrangements through the Rail North Partnership;
 2. Include the next stage of 'double devolution' to provide city regions and other local areas with even greater autonomy to deliver fully integrated public transport networks with common fares and local accountability;
 3. The industry structured with a single region for the North with a single North of England train operator (to provide economies of scale but internally structured around locally accountable business units);
 4. A separately identified budget for the North (which the North can prioritise against) with the ability to invest to grow revenue and recycle it in the North;
 5. A statutory role on rail investment, so that Transport for the North (and partners) are involved at every stage of development and delivery of investment projects; and
 6. Transport for the North's statutory Strategic Transport Plan to underpin a growth plan for the North which links the role of the railway with wider economic growth, decarbonisation and social exclusion.
- 3.18 Given the pressing need to address the problems in the North highlighted in this report and the fact that we already have the first stage of devolution in the form of Rail North Partnership, the North is well placed to make progress with rail reform by building on the existing arrangements. The work undertaken to date preparing for GBR enables the North to deliver reforms quickly to the benefit of rail users (both passenger and freight) whilst working within the current financial framework set nationally. Appendix 2 sets out a number of 'quick wins' that could form an 'offer' to government to deliver many of the benefits of rail reform ahead of the legislation. These include:
- Double devolution through Regional Business Units (including Mayoral Combined Authorities);

- Fares and ticketing reform building on existing powers; and
- Transformed stations and ticket retailing in a way that works for the North.

3.19 Appendix 2 also sets out a longer-term proposition for Rail Reform in terms of a new Partnership between Transport for the North and Great British Railways or similar organisation. These include:

- A joint long-term plan for the railway based on Transport for the North's evidence-based and statutory Strategic Transport Plan;
- A clear articulation of both the services and infrastructure required to support the plan;
- A 'profit and loss' account setting out the funding available to allow prioritisation decisions by Northern Leaders; and
- The next step of 'Double Devolution' to empower city regions and other areas to take a greater role in rail as part of wider integrated networks.

Funding

3.20 Fixing the problems and growing the railway in the way set out in this report will require sufficient funding for both rail services (revenue) and infrastructure (capital). Historic under-investment in infrastructure is part of the cause of long-running performance problems across the North (for example congestion hotspots of Central Manchester, the East Coast Main Line North of York and for services passing through Leeds).

3.21 The Board has consistently raised concerns that the planned operational budgets for Northern and TransPennine Express are insufficient to support the strong growth back post-covid or the full restoration of the previous quantum of services. There are further significant risks around inflation (which is not factored into train operator budgets). The impact is likely to be cuts to services rather than the growth needed to support the Strategic Transport Plan and Independent Economic Review.

3.22 The original Northern and TransPennine Express franchises (back in 2016) were let on the basis of 'invest to save'. Investment in new trains and services was designed to encourage more passengers and reduce the subsidy over time. Covid may have re-set the baseline, but the principle of invest to grow (and reduce the cost to Treasury over time) should continue to underpin our approach. The strong bounce-back post-covid shows the underlying strength of the market for rail in the North if the offer is right.

3.23 The situation elsewhere across England is one where revenues are still well below pre-pandemic levels. At present Treasury is only focused on the cost side of rail services. By ignoring the revenue dimension there is the very real likelihood that the impact of inflationary pressures on the rail service budget will be applied equally across the country. Such a situation may see rail services in the north (that are contributing to revenue growth) having to be cut whilst services elsewhere in the country are maintained.

3.24 At a time of financial pressures, it is essential that in determining the budgets for train operators the Government takes account of revenues and costs. Such an approach is essential to ensure that the North is not disproportionately affected. It is recommended that TfN write to the Rail Minister on this issue as a matter of urgency.

3.25 All of TfN's evidence and technical work demonstrates the critical role that growing the rail system has to play in unlocking the North's potential – not just in terms of enabling a more sustainable pattern of travel, but in terms of acting as a

catalyst for private sector investment. We have seen how the area around St Pancras/Kings Cross has regenerated, in part because of the investment in the railways. Likewise, Curzon Street is another example of the catalytic effect for private sector investors that a commitment to rail investment brings. There is a need for the North to actively campaign on the opportunities that rail investment brings to economic growth. Transport for the North has commissioned work on the value of rail across the North of England which will be available shortly as part of a brochure setting out the case for intervention in the North.

4. Corporate Considerations

Financial Implications

4.1 There are no financial implications for Transport for the North as a result of this report. The report highlights the risk that there is insufficient funding for current and future rail services.

Resource Implications

There are no direct resourcing implications as a result of this report.

Legal Implications

Transport for the North's Constitution will be kept under review in case any amendments are required. Contract management of the train operators is undertaken by the Rail North Partnership in accordance with the DfT's contractual mechanisms.

Risk Management and Key Issues

This paper does not require a risk assessment, however, risks relating to the future of rail services are highlighted. A risk has been included on the Transport for the North Corporate Risk Register in relation to the future viability of rail services and Transport for the North's future role.

Environmental Implications

This report does not constitute or influence a plan or programme which sets the framework for future development consents of projects listed in the EIA Directive and therefore does not stimulate the need for SEA or EIA. Any infrastructure proposals to improve the capacity and reliability of the system will be subject (where appropriate) to EIA Screening, conducted by Network Rail as part of the consenting process for those projects.

Equality and Diversity

A full impact assessment has not been carried out because it is not relevant to the type of work referenced.

Consultations

A consultation is not required on the issues covered in this paper.

5. Background Papers

5.1 None

6. Appendices

6.1 Appendix 1: Northern Powerhouse Rail Current Position

6.2 Appendix 2: Rail Reform Quick Wins and Longer-Term Proposition

Glossary of terms, abbreviations and acronyms used (if applicable)

Please include any technical abbreviations and acronyms used in the report in this section. (Please see examples below.) This will provide an easy reference point for the reader for any abbreviations and acronyms that are used in the report.

- a) TPE TransPennine Express
- b) NPR Northern Powerhouse Rail
- c) RNP Rail North Partnership
- d) GBR Great British Railways
- e) STP Strategic Transport Plan
- f) HS2 High Speed 2
- g) NPIER Northern Powerhouse Independent Economic Review
- h) TRU Transpennine Route Upgrade

Appendix 1 – Northern Powerhouse Rail Current Position

- 1.1 To provide the level of rail connectivity, capacity and reliability required to support the North's sustainable economic growth, delivery of a number of major rail programmes to complement smaller scale enhancements is important. These include:
- The Transpennine Route Upgrade (TRU), which will provide an electrified and upgraded route between Manchester and York via Huddersfield and Leeds. It will offer faster more reliable journeys, more seats and also capability for container freight trains;
 - High Speed 2 (HS2), which will link the North to the Midlands and London and also to Scotland. It will provide significantly faster journeys with a major uplift in seating capacity; and
 - Northern Powerhouse Rail (NPR), linking the major cities of the North to each other and Manchester Airport through new lines and significant upgrades, providing more frequent and significantly faster journeys, whilst supporting greater economic interaction in the North.
- 1.2 These major programmes are integral to achievement of the emerging Strategic Transport Plan (STP) targets Vision and Objectives and proposed outputs of the draft Rail Connectivity Policy that will support the STP. They are integral parts of the North's rail network and need to be planned as such so that the benefits can be spread to areas not directly served (e.g. through better links to hub stations using the existing network and through released capacity allowing better services elsewhere).
- 1.3 TRU is an essential medium-term programme providing journey times of 41-42 minutes between Manchester and Leeds and 63-66 minutes between Manchester and York. It will provide the capability to double the number of available seats and allowing the market to grow. TRU is an essential first step to the longer term NPR programme, not an alternative to it. TRU also provides some early parts of the NPR network.
- 1.4 Transport for the North has consistently supported HS2 because we believe it will play a key role in achieving our ambitions and improving the quality of life across the North. It will expand the existing rail network, regenerate railway stations and their surrounding areas, and support the delivery of NPR, which will free up much-needed North-South and East-West capacity in a system that is struggling to perform. HS2 and NPR (as well as TRU) also offer important benefits in reduced emissions. They can and should be part of the approach to decarbonisation.
- 1.5 HS2 is also important in providing some of the NPR network. In our view, there is no hierarchy between HS2 and NPR and this should be reflected in terms of train service planning – NPR needs to be able to provide the services that the North needs rather than having to fit around HS2. There is now a clear opportunity to ensure that, alongside the TRU and East Coast Mainline Upgrade, HS2 and NPR deliver a transformation in rail fit for future generations that can be spread across the whole of the North through integrated planning.
- 1.6 Transport for the North's position is that the full HS2 network needs to be delivered to maximise the benefits of HS2 to the North (i.e. both the Western leg but also the Eastern leg from Birmingham to Sheffield, Leeds and the North East). The Eastern leg is important to providing better connectivity for major centres to the Midlands and London and is an integral part of NPR corridors between Sheffield, Leeds and Newcastle. Transport for the North has stressed the

importance of completing the Eastern leg in full. Construction of the Western leg and an NPR route from Manchester to Leeds is not an alternative to the Eastern leg – this does not work in capacity terms. Both the Western and Eastern HS2 legs are needed to fully benefit the North and also avoid unintended economic imbalances.

- 1.7 Both NPR and HS2 are integral parts of the North's rail network that build on from investment along the TRU corridor. It is therefore essential that all are planned as part of the wider rail network and not in isolation to it, because they are all essential components to deliver the rail strategy set out in the Strategic Transport Plan and to achieve its wider goals.
- 1.8 The Board agreed its preferred network for NPR in 2021 and provided statutory advice to the Secretary of State for Transport. The Board's agreed network is:
- A new line to be constructed from Liverpool to Manchester via the centre of Warrington and Manchester Airport;
 - A new line to be constructed from Manchester to Leeds via the centre of Bradford;
 - Significant upgrades and journey time improvements to the Hope Valley route between Manchester and Sheffield;
 - A combination of new lines (including the new station at Leeds), significant upgrades, and new stations at Rotherham and Barnsley Dearne Valley, in order to improve the network between Sheffield and Leeds;
 - Significant upgrades and electrification of the rail lines from Leeds and Sheffield to Hull; and
 - Significant upgrades of the East Coast Main Line from Leeds to Newcastle (via York and Darlington) and restoration of the Leamside Line (providing an alternative route from the ECML south of Durham into Newcastle).
- 1.9 Full delivery of the Transport for the North Preferred NPR network will have significant journey time and capacity benefits as more frequent and longer trains would operate. NPR also has the potential to benefit places not served by it directly; for example, Preston to Hull could be 35-40 minutes faster, and Wakefield to Liverpool 25-30 minutes faster than today.
- 1.10 In addition to rail benefits, delivery of NPR in full supports the creation of an integrated and interconnected Northern economy. NPR has significant wider economic benefits, including:
- A Gross Value Added uplift valued at £3.4 billion per year in 2040, rising to £14.4 billion by 2060;
 - Expanding labour market opportunities, bringing an additional 3.8 million people within 90 minutes of four or more Northern cities;
 - Increasing land value and attracting regeneration to some of our more deprived areas;
 - Over 100,000 more jobs in our urban areas and up to 20,000 additional businesses in the North by 2060;
 - Increasing capacity to cope with forecast growth in demand;
 - Removing up to 20,000 tonnes of CO² per year by 2040 by removing diesel trains from our network and taking 58,000 car trips per day off the road; and
 - More than doubling the number of people able to access Manchester Airport by rail within 90 minutes.

- 1.11 Full completion of the Western leg of HS2 to Manchester, and completion of the Eastern leg of HS2 between Leeds and the junction with NPR at Clayton in South Yorkshire, will also help to enable the full NPR service to operate better. A connection from the Marple line to HS2 in Manchester, in order to enable NPR from Sheffield to Manchester Airport and Liverpool, would perform a similar function. This emphasises the complementarity of HS2 and NPR in providing effective East-West and North-South routes across the North, thereby supporting economic interaction, with TRU providing medium-term benefits whilst the completion of HS2 and NPR is awaited.
- 1.12 The Government's Integrated Rail Plan for the North and Midlands (IRP) published in November 2021 set out its views on the North's future rail network. In summary, it proposed partial new line solutions between Liverpool and Manchester and between Manchester and Leeds, with upgrades elsewhere. It committed to completion of the Transpennine Route Upgrade and suggested this should be seen as Northern Powerhouse Rail Phase 1.
- 1.13 As a result, the IRP Manchester to Leeds corridor would be a new line from Manchester as far as Marsden, then using an upgraded TRU route via Huddersfield. Bradford would not be served by NPR, and the IRP does not propose NPR solutions in the Sheffield to Manchester, Leeds to Hull or Sheffield to Hull corridors.
- 1.14 The IRP proposed that the HS2 network would be London to Manchester, with the Golborne Link connection to the West Coast Main Line south of Wigan, but with the Eastern leg of HS2 curtailed in the East Midlands; trains would reach Sheffield via upgrades to the existing rail network. How HS2 trains reach Leeds, and any improvements between Sheffield and Leeds, are to be subject to further study. A subsequent announcement removed the Golborne Link from the HS2 scheme, with options to connect to Wigan and places north to be subject to further study.
- 1.15 Whilst fairly extensive, the Integrated Rail Plan's NPR and HS2 networks do not fully meet Transport for the North's preferred network in several ways:
- Bradford and Hull are not served by NPR;
 - There are no proposals to improve the Sheffield to Manchester corridor beyond what is already authorised;
 - Liverpool is served by an upgraded freight line via existing stations;
 - The upgrades north of York do not provide the full Transport for the North NPR specification, and do not include reinstatement of the Leamside Line;
 - Major existing capacity issues at Leeds would not be addressed;
 - The Eastern leg of HS2 is curtailed, increasing Sheffield to London journey times and leading to a lack of clarity on how or if Leeds would be served, or how the Leeds to Sheffield NPR corridor would be served;
 - The subsequent Golborne Link announcement creates uncertainty as to how much Wigan and stations in Lancashire and Cumbria will benefit from HS2; and
 - No wider economic assessment of the IRP proposals has been carried out, so it is unclear what the impact of these schemes would be on the North's economy.
- 1.16 The House of Commons Transport Select Committee conducted an inquiry into the Integrated Rail Plan in 2022. The Committee in its report welcomes the scale of the IRP investment although it calls for a thorough re-assessment of the IRP, taking into account wider economic impacts thereby allowing a proper comparison

of costs and benefits to be made. If this comparison finds that alternative NPR options, such as the Board's preferred network perform better, the Committee calls for the IRP to be revisited. The Committee is also concerned about the focus on upgrades and the level of disruption this would cause. The report casts doubt on the focus on journey times, rather than capacity, and whether these reductions are achievable on upgraded routes. Concerns are also expressed on choices on NPR sections, stations and on the curtailment of the Eastern leg of HS2. The Government has yet to respond to the Select Committee's findings.

- 1.17 The previous Prime Minister had stated her commitment to delivering NPR in full and that NPR would serve Bradford, in effect revisiting the IRP. Following the most recent change of Prime Minister in October 2022, it is now clear that the IRP version of HS2 and NPR, or "core Northern Powerhouse Rail network" is that to which the Government is committed, and which was supported in the Autumn 2022 Spending Review, although the Government is assessing options for Bradford with regard to a new station and better connecting Bradford. As a result, the gaps between the core and Transport for the North NPR networks remain.
- 1.18 The Transport for the North-preferred NPR and HS2 networks remain the long-term aim for rail connectivity in the North, supported by full delivery of TRU in the medium term. Together, these form a coherent plan for major rail investment in the North to support sustainable economic growth, underpinning the aims of the Strategic Transport Plan. The improvements proposed in the IRP are a first step to this aim, but do not fully achieve it. Expediting delivery of the non-abortive elements of the IRP proposals is beneficial, and Transport for the North will continue to work with the DfT, Network Rail and Transport for the North's partners to secure the investment needed to deliver the Transport for the North-preferred network.
- 1.19 The Transport for the North STP sets out a 30-year vision to support sustainable growth of the North's economy, and the full NPR and HS2 networks are important to achieve this. They will inevitable be delivered over time and many elements do not require significant capital funding at this time. Transport for the North will therefore seek to work with the Department for Transport to develop the case for the full network, including collating work already done as part of NPR development, so that schemes can be considered for future funding commitment when needed.

Appendix 2 – Outline Rail Reform Proposition

Quick Wins, which can be implemented within existing structures

What	How	Where	When	Why
Regional Business Units	Greater disaggregation within the Rail North Partnership to provide more local input and ownership	North East North West Others TBC (Exploratory discussions happening in the 'East')	In existence since 2016 Proposed from April 2023	Better rail services that meet local needs, for example through input to operator Business Plans, through locally targeted fare revisions, to work with operators to improve performance, to work with operators to plan disruption and to feed in local knowledge.
Pay as You Go (PAYG) ticketing	Payment by contactless card/smart card/phone or other media. Pay per use rather than buying a specific ticket in advance, knowing that the cheapest fare will be charged.	Initially in pilot areas followed by wider rollout.	Government has committed to this across "commuter networks" in the Midlands and North by 2024 Already in operation on some light rail and bus networks in the North.	To provide a better experience for customers with better value. Removes the need for paper or other forms of tickets. Experience from London is that PAYG leads to increased passenger numbers.
Fares reform	Use of existing powers within the Rail North Partnership to set fares	Potentially North of England-wide however likely to be initially deployed in the city regions and surrounding areas to enable pay	From 2023 onwards	More attractive fares that better meet customer need. Greater integration with other modes of travel and other retail offers. Ability for targeted

What	How	Where	When	Why
		as you go ticketing.		variation to address need. Increased passenger numbers and revenue.
Transformed stations and ticket retailing	Programme of improvements to stations in the North including better integration with local services and other forms of travel. Builds on Northern's Stations as a Place initiative	North of England. Build on work underway in Greater Manchester, West Yorkshire and elsewhere. Needs to be appropriate to the local area so the scale of intervention will vary.	From 2023 onwards	Better stations that meet customer needs with management that respond to local priorities and priorities to provide modern and attractive facilities. Stations as places, integrated with surrounding land use planning to encourage rail use. Achieve efficiencies by aligning funding and investment across partners.
Growth plan for rail	Through aligning the Strategic Transport Plan to support growth in rail	North of England	Consultation in 2023, adoption in 2024	Plan for development of rail over the next 30 years integrating short, medium and long term interventions supported by evidence.

Longer Term Areas for development requiring structural or legislative changes

What	How	Where	When	Why
A joint Strategic Transport Plan that establishes the need for transformation of the North's transport system	By developing the Growth Plan for Rail to include agreed outputs for rail over the next 30 years	North of England	Aim to develop for when GBR (or similar) is established	Jointly agreed plan that provides clarity and certainty over how rail will develop in the medium and long terms to meet the needs of the STP.
Through that joint plan, identification of the role and outcomes required of the rail sector in support of realising the North's economic potential	By reviewing and strengthening the Rail North Partnership Agreement	North of England	Flows from the joint plan work	So that rail services can be more effectively integrated with the North's needs as set out in the Strategic Transport Plan
A prioritised pipeline of investment, expressed in terms of outcomes and against which detailed interventions are developed	To agree what outcomes will be delivered over the next 30 years	North of England (and potential elsewhere e.g. East Coast Main Line and West Coast Main Line)	Flows from the joint plan work	Provides greater certainty for authorities in the North, the rail industry and its suppliers on future investments
The principle of 'double devolution,' used to empower City Regions (and other areas) to enable integration of services at the local level	Greater integration at local level, for example fares, between modes, between rail and economic and land use planning	Specific geographic areas or routes. Initially aligned with devolution deals	Following establishment of GBR (or similar)	Allows rail to play a stronger role in supporting local communities and in supporting economic, environmental and social progress in local areas

What	How	Where	When	Why
Decision-making at the regional and local level to be shaped by a 'profit and loss' account for the North that guides strategic choices, investment and service specification	Allows an overall "balance sheet" of capital and revenue spend to be developed, so that the full financial and wider impacts of developing rail can be illustrated	Would be developed initially on a route basis however in a way that could be expanded to later cover the whole of the North of England	Following establishment of GBR	Helps to strengthen the case for spending on rail in the North and shows the impact of subsidy and costs against public support
The above supported by a strategic partnership between Transport for the North and GBR (or similar)	An overall partnership which oversees the wider rail reform proposition and ensures that the principles are embedded	North of England	Following establishment of GBR	Provides clear links to the GBR Board and the Transport for the North Board, including accountability and oversight of progress

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Meeting:	Transport for North Board Chief Executive Consultation Call
Subject:	Finance and Business Planning update
Author:	Paul Kelly – Interim Finance Director
Sponsor:	Martin Tugwell – Chief Executive
Meeting Date:	Wednesday 14 December 2022

1. Purpose of the Report:

- 1.1 The report captures the latest funding position and the business planning process for 2023/24.
- 1.2 This report sets out the financial performance of Transport for the North (“TfN”) over the first seven months of the financial year 2022/23 and provides the Budget Revision 2 reforecast through to the end of the year.
- 1.3 Detail is also provided with regards to TfN’s performance against its Treasury Management Strategy as required by the TfN Constitution.

2. Recommendations:

- 2.1 It is recommended that the Board:
 - a) Note the financial performance in the six-month period to September 2022
 - b) Approve the Revisions 2 Budget
 - c) Note compliance with the Treasury Management Strategy
 - d) Note the funding and business planning update.

3. Context

- 3.1 The Autumn Statement was a reminder of the pressures on public sector finances, not just for the remainder of the current Parliament but for the immediate period beyond.
- 3.2 As the update on the Northern Powerhouse Independent Economic Review reminds us, the scale of the economic challenge facing the North remains. More importantly though it also reminds us as to the size of the prize to be won by unlocking the economic potential of the North.
- 3.3 TfN was established to make the case on behalf of the North and provide Government with statutory advice on the strategic infrastructure priorities that enable the partners (including Government) realise that economic potential.
- 3.4 TfN’s unrivalled analytical and modelling capability ensures that its advice is grounded in an understanding of where we start from, whilst the overarching narrative for the updated Strategic Transport Plan (STP2) summarises how investment in strategic infrastructure and services will enable that economic potential to be unlocked.
- 3.5 Enabling the cost effective and efficient delivery of that investment is particularly important in current circumstances. In this regard the Department’s recognition of the role of Sub-national Transport Bodies (such as TfN) as regional centres of excellence is particularly welcome. TfN’s offer to its partners (both across the North and nationally) is an opportunity that will be reflected in its Business Planning.
- 3.6 Notwithstanding the pressures on the Department’s capital budget, it is welcome that the Autumn Statement confirmed funding for the Government’s proposals in respect of HS2, TRU and implementation of the Integrated Rail Plan. As noted elsewhere on the agenda, realising the North’s economic potential will ultimately require the

transformative effect of Northern Powerhouse Rail in full. It is therefore essential that TfN continues to work with DfT (and its partners) in the delivery of committed projects, and use the momentum achieved to help make the case for additional funding at subsequent Spending Reviews.

4. Funding Update

- 4.1 As conveyed in the budget papers presented to Board in March and June 2022, the post IRP transfer of the NPR programme to DfT, coupled with the core funding allocation confirmed on 14 February, instigated the need for an organisational restructure and cost reduction programme.
- 4.2 With the support of DfT officials, TfN chose to migrate towards an operating model that was built on capacity and capability with permanent employees as opposed to a reliance on third party consultancy services.
- 4.3 With final appointments being in place within the final quarter, the revised structure and appointees are anticipated to be in place by the final quarter of 2022/23.
- 4.4 At the Board meeting in June 2022, it was also noted that unless subsequent years core funding allocations were increased in line with our cost base, there would, as TFN reserves are systematically utilised, be sustainability issues in the medium-term.
- 4.5 To air and hopefully manage the medium-term sustainability issue, a number of sessions have been conducted with Departmental officials to further explain TfN's cost base and, due to its focus on permanent staff, its limited flexibility.
- 4.6 During these sessions, Departmental officials have been cautious of indicating when the core funding allocation would be confirmed as the implications of the autumn statement would need to be understood.
- 4.7 Departmental officials are however aware of the implications of delaying confirmation of the core allocation and are hopeful of confirmation being possible early in the new year. They also were hopeful that the allocation could extend to the remaining term of the spending review, i.e. to cover the two-year period to March 2025.
- 4.8 During the year, the potential for TfN to offer good value for money solutions acting as a Centre of Excellence has been discussed with Departmental officials. If TfN's core funding allocation were to be extended this would allow TfN to expand its scope of work in support of its partners.
- 4.9 Based on the conversations with Departmental officials, it is reasonable to assume that TfN will be able to conclude its budget and business planning cycles in the required timescales.

5. Business Planning update:

- 5.1 TfN's statutory function and responsibilities remain unchanged. This serves to emphasise the importance of ensuring that TfN's top level target outcomes and objectives are grounded in its work in relation to the Strategic Transport Plan. It also emphasises the importance of ensuring the Business Plan has identifiable "SMART" targets against which progress can be measured and which can inform future discussions with the DfT on funding.
- 5.2 Based on such, TfN's business planning cycle has commenced with a focus on business-as-usual activities centred around its core duties. As clarity emerges around TfN's role as a Centre of Excellence, the business planning process will, if needed, be modified.
- 5.3 Given the continuation of TfN's statutory duties, its current targeted outcomes remain relevant, and these are being used as a basis for business planning:

Strategic Transport Plan

- Consulting on and finalising the Strategic Transport Plan (including the associated Integrated Sustainability Appraisal)
- Updating the Regional Decarbonisation Strategy
- Supporting LTAs to revise their LTPs (subject to DfT confirmation/funding) – noting that revised guidance for LTPs is anticipated in 2023

Shaping the future

- Review TfN Investment Programme against revised STP objectives
- Communicating the North's strategic road (RIS3/4) and rail investment priorities to Government
- Working with Government to realise the benefits of the Rail Reform programme at the earliest opportunity
- Revisiting the Future Travel Scenarios

Implementation through collaboration

- Continuing to work through the Rail North Partnership & through the Strategic Rail team on Manchester Recovery Task Force, ECML and rail operations
- Further work on connected mobility in support local partners, buses and EVCI (subject to DfT funding)
- Continuing to support and shape the development of NPR (working as Co-Sponsor), TRU and HS2
- Work with partners to implement actions set out in Decarbonisation, Freight & Logistics, and Inclusive Transport Strategies

Evidence Based Strategic Thinking

- Continuation of the TfN research programme and thought leadership activity, including the next phases of the NPIER programme
- Implementing the Centre of Excellence, data sharing and Common Analytical Framework (subject to funding)
- Provision of TAME DfT service for NPR (and wider schemes)

5.4 Work around developing TfN as a Centre of Excellence is currently being discussed with DfT officials but will be finalised when more clarity over incremental funding is understood and how this can be delivered alongside TfN's statutory obligations.

6. Year-to-date monitoring:

6.1 The financial performance for the 6 months to September 2022 is summarised below:

	Actuals	Budget	Var.	Var.
	£m	£m	£m	%
Hosted Services				
NPR Programme Closure	£0.23	£0.27	£0.04	15%
NPR Analytical Support	£2.31	£2.63	£0.32	12%
Rail North Partnership	£0.69	£0.83	£0.14	17%
	£3.23	£3.73	£0.50	13%
Operational Areas				
Strategy & Policy	£0.95	£0.96	£0.01	1%
Major Roads	£0.19	£0.18	-£0.01	-5%
Strategic Rail	£0.47	£0.50	£0.03	7%

Back Office	£2.73	£3.36	£0.63	19%
	£4.34	£5.00	£0.66	13%
	£7.57	£8.73	£1.16	13%

6.2 Overall, by the end of September we had planned to spend £8.73m and have actually spent £7.57m, an underspend of £1.16m (13%). This underspend was driven by lower than planned expenditure in Hosted Services and transition costs in Operational Areas.

6.3 **Hosted Services:**

Expenditure of £3.23m YTD represents an underspend of £0.50m (13%). Expenditure in these areas is funded by ring-fenced grants which cannot be repurposed.

NPR Programme Closure:

YTD expenditure of £0.23m is £0.04m below budget. This reflects reduced closure costs due to redeployment of personnel and reduction in infrastructure costs where contractual terms have allowed.

NPR Analytical Support:

Expenditure of £2.31m YTD, represents an underspend of £0.32m (12%). This is predominantly due to a lower than anticipated expenditure rate on the RMAP contract. Discussions are on-going with the DfT regarding additional analysis requirements to make best use of the available funding.

Rail North Partnership:

Expenditure of £0.69m YTD, is £0.14m under budget. This predominantly relates to the TRU contract where there have been two vacancies since the start of the year, one of which has been recruited in September.

6.4 **Operational Areas:**

Expenditure of £4.35m YTD, represents an underspend of £0.66m (13%). This is mainly due to lower than budgeted transition costs. These are partially offset by increased staff costs with the continuation of interim and agency staff while recruitment to the new organisational structure continues. Although further transition costs are pending, it is anticipated that there will be a net underspend in relation to staff and transition of c£0.30m. This one off "saving" will flow into reserves for use in future years.

6.5 There have been a range of virements approved to date and these are captured in Budget Revision 2.

6.6 With the refocus on delivery of TfN's statutory obligations, the opportunity to streamline corporate reporting was considered. From 2022/23, TfN has moved from monthly to quarterly operating reports for external stakeholders but will continue reports monthly at the Operating Board.

7. Budget Revision 2:

7.1 Based upon the latest information, including the position at 30 September, Budget Revision 2 has been constructed. Overall, this revision does not alter the funding envelope, which indicates that the funding approved by the Board in June is expected to be sufficient for the year.

7.2

Expenditure	Original £m	Revised £m	Change £m
Operational Areas	8.84	8.84	-
Rail North Partnership	1.60	1.60	-
NPR Analytical Support	5.66	5.66	-
NPR Closure Costs	0.41	0.41	-
	16.51	16.51	-
Funding			
Core grant	6.50	6.50	-
In-Year funding	0.34	0.34	-
Use of Reserves	1.66	1.66	-
	8.50	8.50	-
Contract Income	0.04	0.04	-
Rail North Grant/Local Contributions	0.30	0.30	-
Core Duties	8.84	8.84	-
<i>Hosted Services:</i>			
TDF Rail Modelling	5.66	5.66	-
Rail North Partnership Grant	0.96	0.96	-
Rail North Grant/Local Contributions	0.35	0.35	-
Contract Income	0.29	0.29	-
NPR Closure Settlement	0.41	0.41	-
Hosted Services	7.67	7.67	-
Total Funding	16.51	16.51	-

7.3 Most of the changes have arisen within Operational Areas of the business, and more detail is provided showing this below.

Operational Expenditure	Original £m	Revised £m	Change £m
Major Roads	0.31	0.47	0.16
Strategy & Policy	2.26	2.17	- 0.09
Strategic Rail	1.20	1.35	0.15
Business Capabilities	2.46	2.46	-
Finance	0.82	0.60	- 0.22
Leadership	0.35	0.35	-
	7.40	7.40	0.00
Transition costs	1.44	1.44	-
Total Operational:	8.84	8.84	0.00

7.4 The Finance budget line has been used to capture the savings required to support virement to date. This will correct later in the year as other savings are realised.

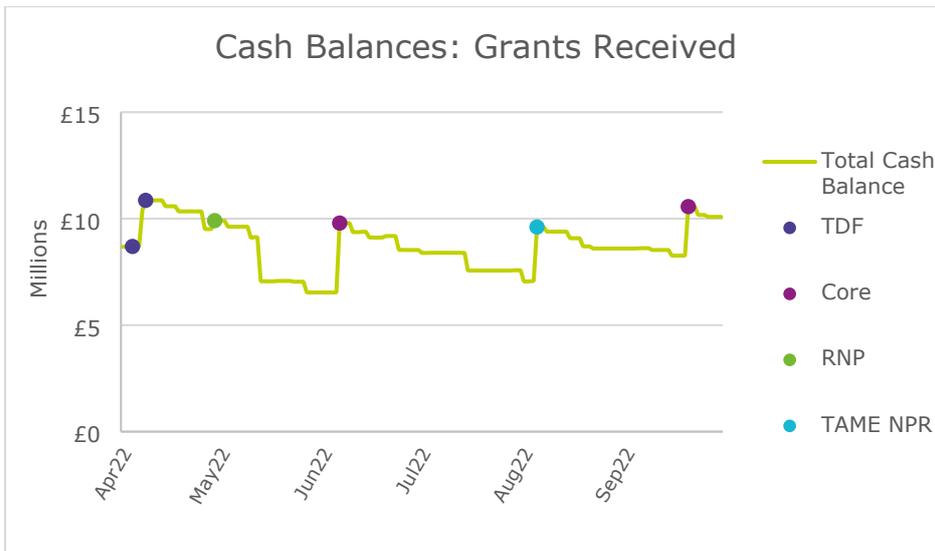
Savings in the region of £0.3m are anticipated in transition costs. Any saving in this area will increase reserves for financial planning of future years.

8. Mid-Year Treasury Management Update:

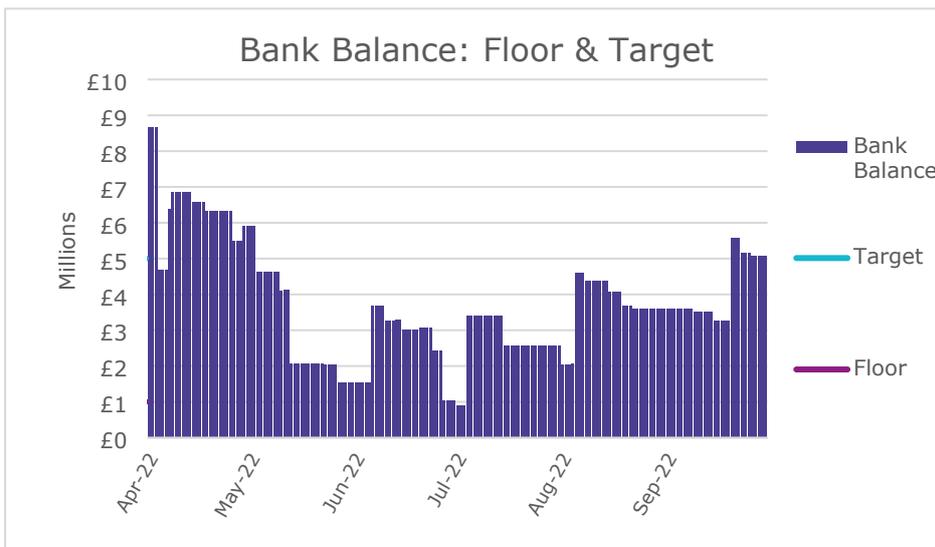
8.1 TfN's constitution obliges officers to report to Board at the mid-year mark on performance against the Treasury Management Strategy. Unlike many partner bodies, TfN is prohibited from borrowing. Therefore, the strategy directs how TfN will manage cash and investments. This information was shared with the Audit and Governance Committee in November. To date, TfN has operated within the parameters set out in its Treasury Management Strategy.

8.2 The following charts show performance against key parameters. It shows that TfN has managed cash and investments within its counterparty criteria, placing cash deposits with secure bodies and institutions on liquid terms.

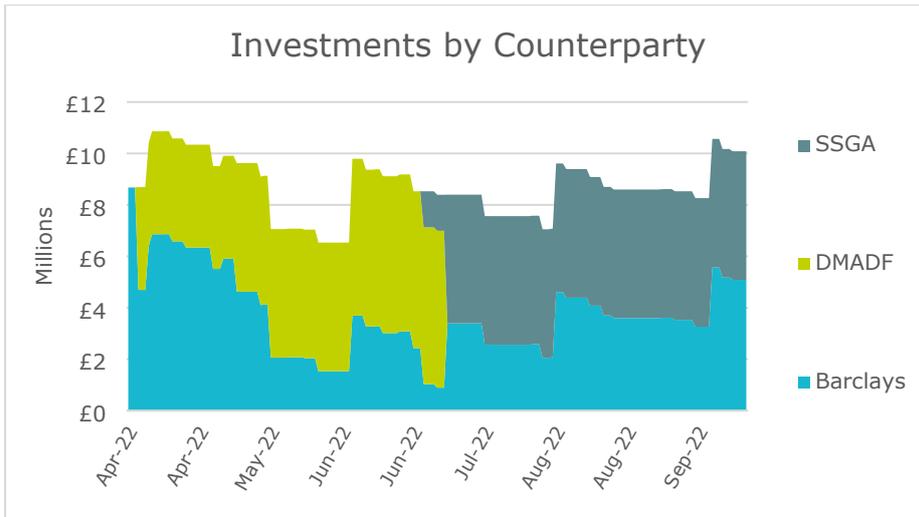
8.3



8.4 The principal source of income is grant from DfT which is received periodically leading to the pattern of cash balances shown above i.e. a peak on receipt of grant followed by a gradual run down of balances until the next grant instalment is received.



8.5 We aim to ensure that an adequate but not excessive balance is maintained in the main business bank account. This gives us a target of holding between £1m and £5m. As can be seen above, the business bank balance has usually fluctuated between these values. For three days in July we held a balance just below the floor (£0.9m) as we transitioned between investment types. In full compliance with our Treasury Strategy, at times we have held a balance above £5m, invariably linked to optimising our investment strategy. Although interest and dividends have been improving in recent months, in the early part of the year the interest return on our business account was favourable compared to alternatives at a similar level of security which were available.



8.6 During the year we have sustained a suitable balance in Barclays, our business bank account. Interest rates started to change in June/July and in response to better yields being available, with high levels of security, we shifted temporarily surplus funds away from DMADF (UK Government) into a money market fund with SSGA (AAA credit rated by S&P and Fitch).

8.7 It is worth noting that the interest rate environment has been changing significantly recently with new opportunities becoming available for secure investment of temporarily surplus cash. We are likely to see new counterparties emerge in the remainder of the financial year.

8.8 However, whilst we will continue to keep the position under review there is no intention at present to change the focus of our Treasury Management Strategy and its prioritisation on security and liquidity over yield.

9. Corporate Considerations:

Financial Implications

9.1 The financial implications are included within the report.

Resource Implications

9.2 The HR implications are covered within this report.

Legal Implications

9.3 The Legal implications are covered within this report.

Risk Management and Key Issues

9.4 The risk implications are included within the report.

Environmental Implications

9.5 There are no environmental implications.

Equality and Diversity

9.6 There are no quality and diversity matters.

Consultations

9.7 No consultation is required.

10. Background Papers:

- 10.1 2022/23 Interim and Final Budget
- Treasury Management Strategy

Glossary of terms, abbreviations and acronyms used (if applicable)

Please include any technical abbreviations and acronyms used in the report in this section. (Please see examples below.) This will provide an easy reference point for the reader for any abbreviations and acronyms that are used in the report.

- a) IRP Integrated Rail Plan
- b) NPR Northern Powerhouse Rail
- c) STP Strategic Transport Plan

Meeting:	Transport for the North Board Chief Executive Consultation Call
Subject:	Transport and Health Policy Position
Author:	Tom Jarvis, Senior Evidence & Analysis Officer
Sponsor:	Tim Foster, Interim Strategy & Programme Director
Meeting Date:	Wednesday 14 December 2022

1. Purpose of the Report:

- 1.1 To introduce TfN's draft Transport and Health Policy Position, provided in Appendix One.

2. Recommendations:

- 2.1 That the Board approves the Transport and Health Policy Position as set out in Appendix 1 to this report.

3. Main Issues:***Policy position background and context***

- 3.1 In 2022/23, Transport for the North (TfN) undertook research with Cambridge Econometrics and Cavill Associates on the impacts of the transport system on health and wellbeing. This research brought together evidence on the range of impacts of the transport system on health and wellbeing, quantified these impacts, and facilitated analysis of variations in these impacts across the North. The research report produced from this is included as a background paper.
- 3.2 The research demonstrated a clear health inequality challenge in England. For example, the 2019 English Indices of Deprivation found that the North contains over double the number of areas with very high levels of health deprivation than would be expected based on the population share alone.
- 3.3 The causes of health and wellbeing inequalities in England are multiple and complex. However, both TfN's research and the wider body evidence on the determinants of health and wellbeing in England demonstrate that the transport system has a significant role. The five key impacts highlighted in TfN's research are: (1) Road traffic incidents and safety, (2) access to healthcare, (3) air pollution, (4) noise pollution, and (5) physical inactivity.
- 3.4 The draft policy position reflects and responds to a number of challenges. These include the complex and multi-dimensional relationship between transport and health, the fact that health impacts from transport often fall on non-users and are therefore not reflected in user costs, and the need to reduce levels of car-dominance and car-dependency if significant progress is to be made on reducing negative health externalities from the transport system.

TfN's role on transport and health

- 3.5 The draft policy position sets out the following actions for TfN to respond to the challenge evidenced by the research:
- 1) *Vision zero for the major and strategic roads network:* TfN will adopt a vision for zero deaths and serious injuries on the major and strategic roads network by 2050, and will consider this vision in developing future policy related to this network. Both Transport for London and Transport Scotland have taken a similar stance in relation to their transport networks.

- 2) *Enhance links with OHID and local Directors of Public Health:* TfN will enhance its links with the Office for Health Improvement and Disparities (OHID) and with local Directors of Public Health in the North. This will develop new arrangements for evidence sharing on the impacts of transport on health, and identify evidence gaps of mutual interest.
- 3) *Enhance evidence on access to healthcare and links to health inequality:* Despite methodological development undertaken in 2021/22, it is not currently possible to quantify the link between changes in access and changes in health outcomes. Subject to available resources, TfN will undertake research to address this significant evidence gap.
- 4) *Develop a severance tool:* In 2021/22, TfN developed a methodology to estimate severance effects caused by major road and rail infrastructure. However, the level of data required, and the methodological complexity of this approach, means that it is not easily transferable to other contexts. Subject to available resources, TfN will work to overcome these methodological challenges, and provide a transferable tool for Local Authorities to estimate the severance impacts of road and rail infrastructure.
- 5) *Develop a broader impacts costing tool and estimate for the North:* TfN will collate existing evidence and, if required, conduct additional research, to establish the whole systems impacts of different transport modes in the North and carry out a comparative analysis against existing pricing models. This is with the intention of supporting policy-makers in decisions on road user charging, parking policy, public transport fares, and investment in active travel.
- 6) *Support partners in identifying areas with poor access to health services:* TfN's transport-related social exclusion data tool allows Local Authorities and other stakeholders to access Lower Layer Super Output Areas (LSOA)-level data on access to jobs, education, and key services – including healthcare. TfN will promote this tool and provide support to partners in using it to identify areas in where there is both poor access to healthcare and high levels of need.
- 7) *Measure progress towards health outcomes:* TfN's Monitoring and Evaluation Framework includes several health-related metrics and provides a transparent means of monitoring progress towards the ambitions set out in Strategic Transport Plan.

Next steps

- 3.6 The policy position and supporting research will be published by TfN and will inform the development of the second Strategic Transport Plan being prepared by the Executive. In addition, this work, together with TfN's work on Transport Related Social Exclusion, provides the evidence base that will enable the wider benefits and implications of proposed transport solutions to be fed into their business cases.

4. Corporate Considerations

Financial Implications

- 4.1 There are no direct financial implications arising from this report. The financial implications of further work will be considered as part of the business planning and budgeting process for future years.

Resource Implications

- 4.2 Any resourcing implications to TfN as a result of this policy will be considered as part of TfN Business Planning Process for FY2023/24.

Legal Implications

- 4.3 Transport for the North has a statutory duty to prepare a Strategic Transport Plan (STP) and the Health Policy Position forms part of the preparation for the revised STP.

Risk Management and Key Issues

- 4.4 There are no risk implications arising from this report.

Environmental Implications

- 4.5 This report does not constitute or influence a plan or programme which sets the framework for future development consents of projects listed in the Environmental Impact assessment (EIA) Directive and therefore does not stimulate the need for Strategic Environmental Assessment (SEA) or EIA. The protection and enhancement of health and wellbeing is an important objective within our existing STP and intrinsically linked with a fair decarbonisation transition within TfN's Decarbonisation Strategy. This policy position and the activities laid out within it, will support the objectives of both these documents.

Equality and Diversity

- 4.6 The draft policy position responds to evidence of significant health inequalities in England, and the concentration of poor health outcomes in the North. These health inequalities are known to disproportionately impact those on low incomes, people with disabilities, ethnic minority communities, and young people. The actions set out in the draft policy position are intended to develop evidence and support TfN's partners in addressing these inequalities, where they relate to transport.

Consultations

- 4.7 None

5. Background Papers

- 5.1 Transport, Health, and Wellbeing research report

6. Appendices

- 6.1 Appendix 1 Draft Transport and Health Policy Position

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Transport for the North

Transport, health and wellbeing in the North of England



public health consultancy



Contact:	Chris Thoung, Cambridge Econometrics
Authors:	Georgios Maridis, Cambridge Econometrics Lee Robinson, Cambridge Econometrics Daniel Seymour, Cambridge Econometrics Dr Nick Cavill, Cavill Associates Professor Harry Rutter
Contributors:	Dr Adam Brown, Cambridge Econometrics
Project director:	Chris Thoung, Cambridge Econometrics

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Executive summary

This project looked at quantitative evidence on transport, health and wellbeing in the North of England

A portion of the evidence base is amenable for quantitative analysis...

...but other elements of the framework lack both evidence and data

Results

- Transport for the North (TfN) commissioned Cambridge Econometrics (CE), with Cavill Associates, to improve understanding of how transport affects health and wellbeing in the North of England.
- The purpose of this work was to shed light on the various transport impacts to inform: the further development of TfN's Strategic Transport Plan (STP), TfN's Decarbonisation Strategy, and TfN's capacity to analyse the impacts of transport in the North.
- The project considered ten areas (impacts) in which transport might affect health and wellbeing, with:
 - a review phase to: establish the state of the evidence base on each of those impacts, supported by expert consultations to augment the evidence base and our understanding of the causal relationships
 - the development of an impact framework with which to take the evidence and show whether and how it might be combined to inform quantitative assessment
- The review phase identified three tiers of evidence:
 - 1 Evidence supported by a body of robust quantitative data permitting further analysis: these were taken forward into the quantitative analysis presented in this report – physical inactivity, incidents and safety, green space and noise pollution.
 - 2 Evidence supported by quantitative data but with weaker or less conclusive results, possibly with more complex causal chains and/or data limitations for analysis: one of these was taken forward for quantitative analysis and another, severance, was tested as a small example case to see if there might at least be some way to identify potential risk of social disconnectedness.
 - 3 Evidence on the likely direction and scale of the effects but little in the way of concrete evidence with which to carry out any quantitative analysis: user experience, access to healthcare, access to employment and environment quality.
- The impact framework sets out the evidence base as a whole but also a summary of the evidence most useful for quantification. In cases in which quantification is currently possible, we put forward recommendations and analysis to show how the framework can be applied. For impacts which cannot (currently) be assessed, the focus is more on limitations and how data gaps might need to be addressed.

¹ The analysis in this part of the report was only able to consider road transport as a whole, rather than isolating public from private transport.

- air pollution, especially in the form of nitrogen dioxide (NO₂) and particulate emissions, which raise the risk of hospitalisation and mortality much more than the other pollutants considered
- noise, as a source of stress that raises the risks of coronary heart disease, hypertension and depression
- Our analysis shows the availability of walking and cycling routes for exercise and of parks in urban areas, highlighting that these routes should be promoting activity for those in the vicinity and that the impacts of parks are positive small.
- In terms of green space more generally, lower availability in urban centres (here, with a focus on Manchester) may have distributional implications given the tendency for people living in those centres to be younger.
- Proximity to green space appears to confer relatively widespread benefits with respect to psychosocial distress. Green space also appears to help reduce the risk of type 2 diabetes though these benefits are much less likely to be in urban centres.

Future directions

- The analysis in this report shows what is currently possible given the available evidence (knowledge of how transport affects health and wellbeing) and the availability of data with which to carry out an assessment. There remain various areas TfN might wish to explore more deeply to expand their ability to analyse health impacts. This specifically concerns: more consideration of access/use rather than simply proximity; and the context-specific nature of traffic incidents (as below). Broader evidence gaps concern access to healthcare and employment, the effects of severance, and user experience.
- Distinguishing between proximity (access/use in principle) and actual access/use is a key challenge for better understanding physical inactivity and green space. Currently proximity is the typical surrogate for usage and exploration of usage and its determinants (or, put another way, barriers) would be valuable.
- The context-specific nature of traffic incidents also makes it challenging to say much in detail because identifying the upstream effects hinders downstream analysis. It is likely that this strand of work would require more detailed and sophisticated prior modelling to augment a health assessment.
- Otherwise, given the presence of impacts of interest but which are lacking evidence and/or data, there are various ways in which further research will be needed to generate more robust analyses and, in time, link them to (possibly new) datasets to shed light on issues of importance such as access to healthcare and employment, severance and user experience.

Executive Summary Table 1: Summary of the estimated number of people at risk, by transport-related health impact and geography

Impact category	Impact	Geography analysed	Estimated number of people at risk in geography ('000s)
Physical inactivity	Lower walking and cycling activity	Greater Manchester	163
Incidents and safety	Number of traffic casualties		33*
Air pollution	Higher risk of mortality from nitrogen dioxide		5,880
	Higher risk of mortality from PM ₁₀		5,850
	Higher risk of mortality from PM _{2.5}		5,640
Limited access to green space, recreation and leisure	Higher risk of type 2 diabetes	The North	9,720
	Higher risk of psychosocial distress		200
	Lower self-rated general health		5,750
Noise pollution	Higher risk of hypertension		2,500
	Higher risk of coronary heart disease		2,500
	Higher risk of depression		2,500

Note(s): * This number does not represent those at risk of traffic incidents but the number of traffic casualties in the North for 2019.
 We did not calculate the number of people at risk for physical activity and subjective wellbeing from proximity to parks and severance.
 For air pollution, only the three most harmful pollutants were considered.

Source(s): Cambridge Econometrics analysis.

1 Introduction

This project considered the impacts of transport on health and wellbeing in the North of England

Transport for the North (TfN) commissioned Cambridge Econometrics (CE), with Cavill Associates, to improve understanding of how transport affects health and wellbeing in the North of England.

The purpose of this work was to shed light on the various transport impacts to inform: the further development of TfN's Strategic Transport Plan (STP), TfN's Decarbonisation Strategy, and TfN's capacity to analyse the impacts of transport in the North.

The rest of this report is structured as follows:

- Chapter 2 sets out our approach to the project
- Chapter 3 summarises the findings of the evidence review on how transport affects health and wellbeing
- Chapter 4 explains the impact framework by which transport impacts can be related, quantitatively, to health and wellbeing
- Chapter 5 presents the results of quantitative analysis from applying the impact framework
- Chapter 6 offers concluding remarks about the work and directions for future analysis

As well as full references (in Chapter 7), the report has various appendices that provide further information from the evidence review including the system maps developed during the first part of the work (Appendix A), a summary of the expert consultations (Appendix B), and a listing of other economic assessment tools in use (Appendix C).

2 Approach

The work was divided into an evidence review phase, and then an impact framework / analysis phase

We divided the project into two phases:

- 4 an evidence review (led by Cavill Associates) to assemble system maps of the channels by which transport could affect health and wellbeing
- 5 the development of an impact framework to operationalise the causal chains (evidence-/data-permitting) and quantitative analysis to illustrate these impacts in the North of England (both led by CE)

These phases of the work correspond to the next three chapters of this report:

- Chapter 3 summarises the findings of the evidence review from Phase 1
- Chapter 4 sets out the impact framework subsequently developed, as the first part of Phase 2
- Chapter 5 goes on to present the results of the data analysis using the impact framework, as the second part of Phase 2

The following sections set out the approach to each part.

2.1 Evidence review (Chapter 3)

The evidence involved three tasks:

- 1 a literature review
- 2 a system mapping exercise
- 3 a series of expert interviews to augment the system maps and the literature assessed

The literature review (review of reviews) built on earlier work by TfN

TfN had previously conducted a high-level review of the main ways that transport influences health. This review identified ten impacts of transport on health and wellbeing. This prior review was taken as a starting point for a search for the best available and most up-to-date data and evidence on each impact. This search focused on reviews, synthesised evidence and high-level reports from authoritative sources (a review of reviews). Primary search engines were PubMed and Google Scholar, using search terms designed to identify as wide a range of relevant reviews as practicable (for example, including 'review' and 'health' in each search along with the specific topic). These searches were supplemented with data and evidence identified through expert consultation. This is an efficient search method that is able to identify key literature in ways that approach the sensitivity of formal systematic reviews, which were not possible given the time and resource constraints of this project.

Initial search results were screened to identify the reviews that provided direct quantitative evidence of the links between transport and the specified health outcome(s).

This literature review produced two main outputs:

- a detailed summary of the quantitative evidence and references

- a systems map showing the connections between aspects of transport and health outcomes (see Appendix A)

Expert consultation augmented and refined the evidence review

The outputs of the literature review were then used to frame interviews with thirteen leading transport and health experts identified by the team to cover the topics under consideration (see Appendix B). These interviews were 30-60 minutes long, conducted on Zoom, and attended by both Nick Cavill and Harry Rutter, and the expert consultee. These discussions were semi-structured and focused on two main tasks:

- 1 Reviewing and updating the systems map, adding in new issues and connections where appropriate. These were added to the map during the interview i.e. in real time (using Kumu mapping software and screen-sharing). In the first part of the discussion, any issue that could be considered to be associated with health outcomes was included, whatever the level of evidence.
- 2 Identifying evidence and data sources that support these transport-health connections, with a focus on quantitative evidence that might be used for an eventual assessment method.

It is important to note that this review did not consider the impacts of the transport system on carbon emissions and climate change more generally, as this issue is covered in other aspects of TfN's modelling. Acknowledging this, the importance of emissions and climate change as having an effect on health and wellbeing was highlighted through the consultation process.

Chapter 3 of the report provides a summary of the evidence reviewed during this first part of the work. As that chapter shows, not all evidence was considered robust enough to support further quantitative assessment.

2.2 Impact framework (Chapter 4)

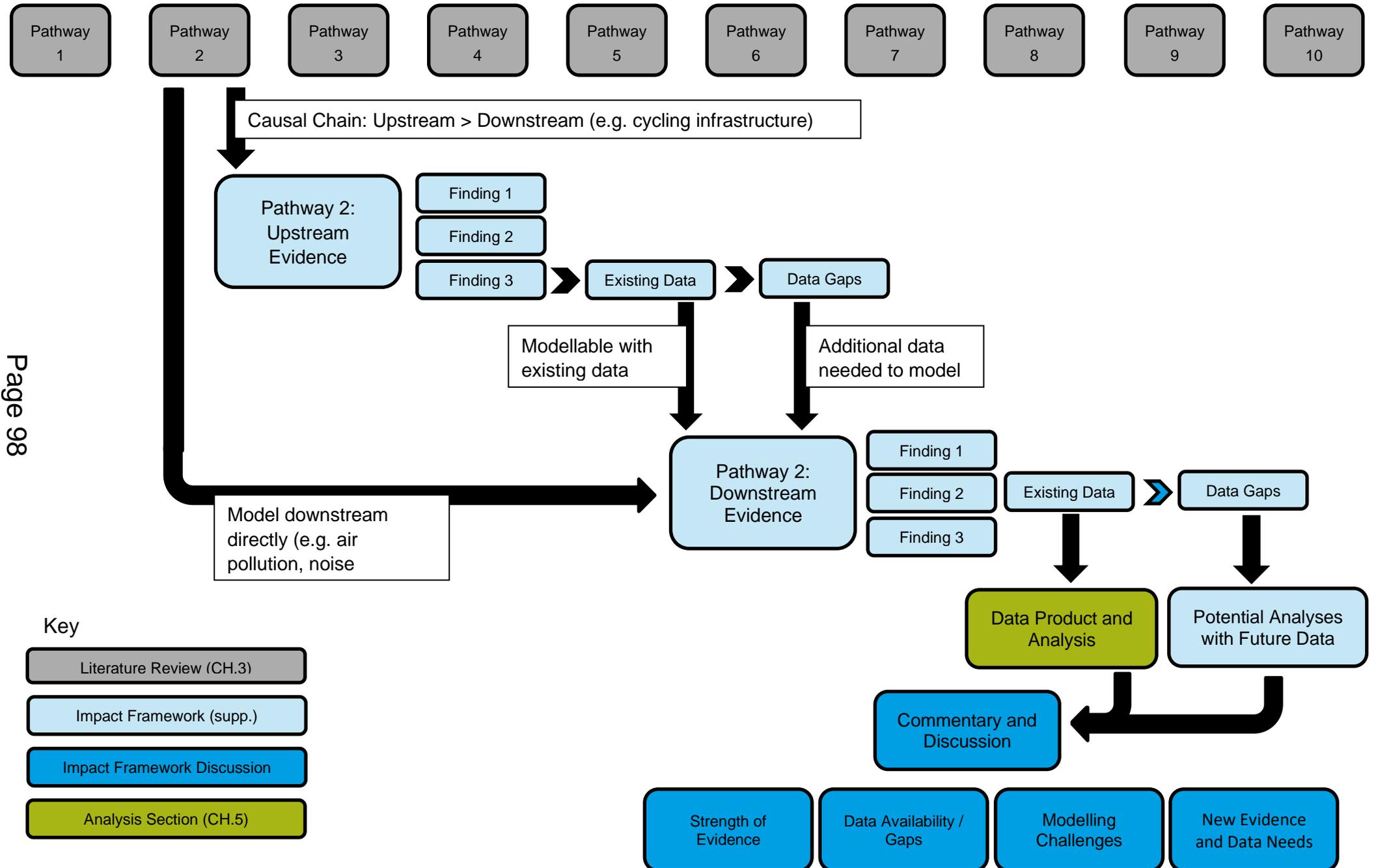
The impact framework uses the evidence base in a way that seeks to establish relevant causal links

While the focus of the evidence review was on what the available literature has to say about the links between transport and health/wellbeing, it is not necessarily the case that this leads immediately to a framework with which to assess the impacts of transport on health and wellbeing.

The purpose of the next step was to develop an impact framework that could operationalise the evidence in a way that could reasonably inform quantitative assessments for TfN's purposes. The focus was to develop the causal chains and evidence in a way that could more clearly establish an impact logic.

The starting point was the evidence base and thinking from the first phase, with the impact framework then assembled by situating that evidence in a causal chain with upstream (causes) and downstream (impacts) effects. From this, we could then consider the data requirements to assess these impacts. Comparisons to the availability of (good quality / appropriate) data then informed the final set of feasible impacts, with commentary/discussion about data gaps that might need to be filled to make other aspects of the impact framework viable.

Figure 2.1: Flow Chart from Evidence to Impact Framework



For each impact, the final impact framework consists of:

- an explanation of the impact logic, extending the causal chains from the evidence (by Chapter 3) and distinguishing upstream from downstream effects
- identification of data requirements to fill the impact framework, alongside an assessment of the extent to which the available data (as part of a data review) support such analysis
- discussion of challenges and data gaps for aspects of the impact framework that cannot (yet) be deployed

Chapter 4 sets out the impact framework with various tables that identify the effects and data requirements/availability. An accompanying spreadsheet consolidates this information, with further technical detail for reference.

2.3 Analysis (Chapter 5)

We also present the results of analysis that makes use of the impact framework

Having stepped through from evidence base to an impact framework, Chapter 5 of this report presents the results of applying that framework.

The principal outputs of this final part of the work are a set of datasets (GIS data layers / shapefiles) to inform future analyses of transport and health/wellbeing. As a demonstration of the approach, Chapter 5 presents elements of the GIS layers to show how they can be used to assess transport-related health and wellbeing effects across the North.

Details of each piece of analysis are covered in Chapter 5 but the general approach has been to:

- 1 use the evidence and available data to construct estimates of the 'footprint' (spatial distribution) of a health/wellbeing effect e.g. the health risks associated with certain air pollutants and how those risks vary across the North according to pollutant concentration
- 2 overlay this footprint of effects on to some spatial representation of the population that might be affected, to estimate the overall impacts

By making this distinction between *where the effects are*, and *how they have impacts on the population of the North*, the goal was to make, for example, the distinction between high-pollution zones with relatively small resident populations (high risk but low impact/burden) from medium-pollution zones but with very many people living there (medium risk but high impact/burden due to the number of people affected).

We note in some cases that certain kinds of effect can only be reasonably considered in certain parts of the North e.g. in cases in which the underlying literature only concerns cities, or certain impacts (e.g. of green space) in which largely rural areas may be saturated. In such situations we narrow the analysis to more meaningful areas/units of interest.

3 Evidence review

This chapter assesses the evidence on links between transport and health/wellbeing

This chapter summarises the findings from the evidence review of the connections between key aspects of transport and health outcomes. These are presented below on an impact-by-impact basis. This exercise also produced a system map connecting the various causes and effects across the piece. This can be found in Appendix A.

The evidence review focused on ten impacts, which were originally identified and assessed in earlier work by TfN. This original list set the constraints of the review and, while the expert consultation did identify other impacts, none of these additional effects were deemed to be supported by sufficient quantitative evidence to warrant extending the list from the original ten.

The results below summarise the findings from the literature review and expert interviews. They also incorporate helpful comments received from TfN colleagues and wider stakeholders on an earlier draft.

The results that follow are presented in priority order, according to the importance and scale of the health impacts for each topic, as well as the extent of evidence and availability of data for quantitative modelling purposes. This is also based on wider evidence of the health impacts of transport: for example Woodcock *et al.* (2013) found in their modelling study that ‘the pathways that produced the largest benefits were, in order, physical activity, road traffic injuries, and air pollution’.

The review identified three tiers of evidence that vary according to robustness of the quantitative findings and their amenability for further analysis

The prioritisation also divides the impacts into three tiers of evidence, that reflect the extent to the various impacts might be amenable to quantitative assessment and modelling. The three tiers, in descending order of amenability are:

- 1 Evidence from the literature and expert interviews is supported by sufficient quantitative data and robust analysis for it to be possible to characterise the identified relations with high levels of confidence (four impacts).
- 2 Evidence from the literature and expert interviews is supported by sufficient quantitative data to estimate the strength of the relationship. However, either the data were insufficiently comprehensive, or econometric results were not strong enough, for this to be characterised as a robust result (three impacts).
- 3 Evidence from the literature review and expert interviews provides insight as to the direction, approximate scale, and nature of the relationship between two or more variables; however no attempt to quantify this has yet been made (three impacts).

Table 3.1 summarises these tiers and the various impacts.

This part of the assessment only considered the quantitative evidence for relationships between transport and health/wellbeing as presented in the literature i.e., on its own terms. As such, the feasibility of translating the evidence into a useable set of causal chains and numerical values still depends on the availability of the necessary data for the North.

Table 3.1: Summary of evidence

Tier	Impact	Considerations	Main source(s) of evidence
1	Physical inactivity	Converting active travel into volume of physical activity Cycling and walking are directly correlated with all-cause mortality, when controlled for leisure time physical activity Detailed data on active mode networks	Kelly <i>et al.</i> (2014) Zheng <i>et al.</i> (2009) Goodman <i>et al.</i> (2014) Sallis <i>et al.</i> (2016)
	Incidents and safety	Measuring speed and volume of traffic Developing a multi-coefficient model for more accurate prediction (or using a single coefficient model with more limited power to explain)	Hussain <i>et al.</i> (2019) Roshandel <i>et al.</i> (2015)
	Air pollution	Measurements e.g. particulate matter, nitrogen oxides Isolating the emissions arising from traffic	Hoek <i>et al.</i> (2013) Requia <i>et al.</i> (2018)
	Limited access to green space, recreation and leisure	Modelling access, rather than proximity Translating access to use Measuring quality	Twohig-Bennett and Jones (2018) Houlden <i>et al.</i> (2018) Astell-Burt <i>et al.</i> (2014)
2	Noise pollution	Identifying the nature and distribution of exposure Upstream modelling: Forecasting noise	Münzel, Sørensen <i>et al.</i> (2018) Babisch (2014) van Kempen and Babisch (2012) Seidler <i>et al.</i> (2017)
	Severance	Quantifying severance Translating lost connections into health outcomes Quantifying severity of barriers such as roads based on their characteristics	Ancaies (2013)
	User experience	Quantifying active travel and public transport use	Kelly <i>et al.</i> (2017)
3	Limited access to healthcare facilities	Lack of evidence linking transport access and health outcomes	-
	Limited access to high-quality employment	Lack of evidence linking transport access and employment	-
	Environment quality	Lack of evidence linking transport access and environment quality	-

Note(s): Tier 1 - Evidence from the literature and expert interviews is supported by sufficient quantitative data and robust analysis for it to be possible to characterise the identified relations with high levels of confidence.
 Tier 2 - Evidence from the literature and expert interviews is supported by sufficient quantitative data to estimate the strength of the relationship. However, either the data were insufficiently comprehensive, or econometric results were not strong enough, for this to be characterised as a robust result.
 Tier 3 - Evidence from the literature review and expert interviews provides insight as to the direction, approximate scale, and nature of the relationship between two or more variables; however no attempt to quantify this has yet been made.

Expert consultations

Before presenting the summaries by individual impact, we first summarise more general feedback by consultees, which augmented the exercise below. A summary of points discussed by interviewee can be found in Appendix B. A few points of note:

- Internal reviewers (i.e. contacts of TfN, not the consulted experts) raised a number of very pertinent issues regarding additional evidence for the health impacts of transport. Where possible they have been considered here but many of these were supported only by single studies rather than review-level evidence, so have not been included.
- A number of consultees were uncomfortable with producing a system map of transport and health without considering the impact on carbon emissions and climate change (which do of course have very important health impacts). It is understood however that TfN addresses carbon impacts in other parts of its transport models.
- A similar issue arose with biodiversity: road transport is likely to be associated with reductions in biodiversity both as more land is taken up by roads and through surface contamination, run-off, and other forms of pollution. This will have long-term negative health impacts.
- One consultee thought it was inappropriate to separate out access to employment and healthcare and not to also include access to education. Travel to school has different patterns and determinants to other forms of travel; has a great deal of policy focus; and is likely to influence future travel patterns.
- One consultee had been co-author of a high quality review of 'Fourteen pathways between urban transportation and health'. This provided a valuable cross-check to the issues raised in this review. It did however raise some additional topics that may influence health:
 - urban heat islands: this is seen to be currently an issue of low importance in the UK (but may become increasingly important as the climate changes)
 - greenhouse gases: see above comment
 - contamination: this may be an issue worthy of consideration and relates to chemicals and pollutants that can be found on roadway surfaces due to motor vehicle traffic, as a result of road surface, brake, and tire wear – these chemicals and pollutants can contaminate water sources, soils, and air, which pose significant threats to humans and the environment. The consultation highlighted this issue's importance, leading to its inclusion in the system map, but there is currently insufficient evidence to allow it to be quantified and therefore included in the final impact framework.
- It was particularly encouraging that Dr Francesca Racioppi described a hierarchy that was almost identical to Table 3.1 (without having seen this draft report). She has been working closely on the WHO HEAT tool for over ten years, along with other economic models (see Appendix C) (World Health Organization, 2022). The HEAT covers physical activity, road traffic injuries, air quality and carbon. She considered the next 'candidates' for inclusion in the HEAT to be green space and traffic noise.

3.1 Physical inactivity

For physical activity, there is solid evidence on the health benefits of walking and cycling

There is a strong evidence base on the health benefits of physical activity. In adults, there is robust evidence to demonstrate the protective effect of physical activity on a range chronic conditions, including coronary heart disease, obesity and type 2 diabetes, breast and colon cancer, mental health problems, and other health-related issues including social isolation and risk of falls (Department of Health and Social Care, 2019).

High levels of car use are linked with lower levels of physical activity and higher rates of obesity, especially where car use replaces short walking journeys. Walking and cycling for transport provides sufficient health benefits to achieve recommended physical activity levels in most people: for adults, 150 minutes per week of moderate intensity physical activity (MPA) or 75 minutes of vigorous intensity physical activity (VPA), for children and young people, at least 60 minutes of moderate-to-vigorous physical activity (MVPA) per day across the week (Department of Health and Social Care, 2019).

Incorporating physical activity into daily life – primarily through walking and cycling as transport (in contrast to promoting deliberate exercise or sport) – has been consistently recommended as a public health strategy and has been shown to be an effective intervention, recommended by NICE (National Institute for Health and Care Excellence) (2012). Infrastructure for cycling and walking has been shown to be associated with reduced health inequalities (National Institute for Health Research, 2022). A 2014 study evaluating the impacts of a newly-built walking and cycling path in the UK found that proximity to the path was associated with more minutes of physical activity per week (Goodman *et al.*, 2014).

Additionally, access to parks, especially within urban contexts, has a relationship to physical activity. A 2016 study of individuals across 14 different global cities found that the density of parks near residences in urban areas is linearly associated with an increase in daily minutes of moderate to vigorous physical activity (Sallis *et al.*, 2016).

Robust evidence for the quantitative relationship between physical activity and mortality is provided by Kelly *et al.* (2014). Most helpfully, this focuses specifically on walking and cycling, and controls for other forms of physical activity. This means that (in theory at least) their analysis isolates the contribution of walking and cycling to decreased mortality, making the evidence particularly useful for modelling. The study was conducted specifically to provide quantitative input to the World Health Organization's (WHO's) Health Economic Assessment Tool (HEAT) for walking and cycling (World Health Organization, 2022). Kelly *et al.* (2014) report that, for a standardised dose of 11.25 metabolic equivalent of task (MET)² hours per week (or 675 MET minutes per week), the reduction in risk for all-cause mortality was:

- 11% (95% CI: 4-17%) for walking

² The amount of energy expended in a task relative to sitting at rest, which has an MET of 1. Moderate intensity cycling as an MET of approximately 8, so uses 8 times the energy of sitting at rest. Walking at normal speed on a level surface has an MET of around 3.5

- 10% (95% CI: 6-13%) for cycling

3.2 Incidents and safety

Road traffic injuries are context-specific, with the clearest relationship being to traffic speed

The WHO reports that, every year, the lives of approximately 1.3m people are cut short globally as a result of a road traffic crash. Between 20m and 50m more people suffer non-fatal injuries, with many incurring a disability as a result of their injury (World Health Organization 2021).

Road traffic injuries cause considerable economic losses to individuals, their families, and to nations as a whole. These losses arise from the cost of treatment as well as lost productivity for those killed or disabled by their injuries, and for family members who need to take time off work or school to care for the injured. Road traffic incidents cost most countries 3% of their GDP each year (World Health Organization, 2021a).

There is a wide variety of quantitative evidence to describe the nature, prevalence, and severity of road traffic injuries. For example Ang *et al.* (2017) report that 14% of older adults suffer from a road traffic incident, with mortality rates highest among the very elderly adults aged 74 years and above, and pedestrians. Risk to pedestrians is underlined by Charters *et al.* (2017) who report that pedestrians account for a high proportion of overall road traffic fatalities in high-income countries, with pedestrians admitted to hospital twice as likely to die of their injuries than vehicle occupants. There are significant inequalities in road traffic injuries in the UK with children and people from more deprived neighbourhoods disproportionately affected: The Killed or Seriously Injured (KSI) rate per 100,000 population for pedestrians aged 10-14 is approximately 2.6x higher in the most deprived quintile than in the least deprived (30 and 11 respectively). For pedestrians aged 5-9, the most deprived KSI rate is 6x higher than the least deprived rate (18.6 and 3.3 respectively). Among cyclists aged 10 to 14, the KSI rate between 2012-16 was 7.0 KSI in the most deprived quintile of areas compared to 4.2 in the least deprived (public Health England, 2018b).

Some areas of the UK have adopted the Vision Zero approach to road safety (Transport for London, 2021). This approach is common in much of Europe and involves encouraging safe behaviours and designing vehicle and infrastructure to reduce risks.

It is important to note that the risk of a road traffic crash is highly context-specific, making an input into modelling quite challenging. Multiple factors such as collision speed, speed difference, traffic volume and density predict the probability of a collision taking place (Roshandel *et al.*, 2015).

3.3 Air pollution

Air pollution is a major risk factor for premature mortality

In the WHO global burden of disease study, air pollution was ranked fourth as a risk factor for premature mortality, exceeded only by hypertension, smoking and dietary risks. Among environmental risk factors, ambient air pollution was the most important cause of disease, leading to more than 4m premature deaths and more than 100m disability-adjusted life years lost annually worldwide. In 2021, at the launch of new WHO global air quality guidelines, air pollution was called 'one of the biggest environmental threats to human health, alongside climate change' (World Health Organization, 2021b).

Transport-related air pollution contributes to an increased risk of death, particularly from cardiopulmonary causes, with significant social inequalities in the distribution of the impacts (Barnes *et al.*, 2019). It increases the risk of respiratory symptoms and diseases that are not related to allergies. While only a few studies have been conducted on the effects of transport-related air pollution on cardiovascular morbidity, they report a significant increase in the risk of myocardial infarction (heart attack) following exposure. Other studies and the experimental evidence indicate that exposure results in changes in autonomic nervous system regulation and increased inflammatory responses. The WHO International Agency for Research on Cancer has concluded that there is sufficient evidence that outdoor air pollution, including particulates, causes lung cancer to be classified as a carcinogen (Krzyzanowski *et al.*, 2005; IARC, 2013). Of particular concern is exposure to particulates, notably PM_{2.5} and PM₁₀³, especially in areas of housing or schools near busy roads.⁴

Particulates and nitrogen dioxide have the highest health risks

Quantitative evidence is provided by a number of reviews of epidemiological studies. Hoek *et al.* (2013) reports an excess risk per 10 µg/m³ increase in PM_{2.5} exposure of 6% (95% CI 4-8%) for all-cause and 11% (95% CI 5-16%) for cardiovascular mortality. Long-term exposure to PM_{2.5} was more associated with mortality from cardiovascular disease (particularly ischemic heart disease) than from non-malignant respiratory diseases (pooled estimate 3% (95% CI -6-13%).

Requia *et al.* (2018) report that people aged 65+ showed the highest mortality risk for PM₁₀, whereas the youngest age group demonstrated the highest risk for ozone (O₃). There are no studies reporting association between children (aged <5 years) and the pollutants PM_{2.5} and SO₂.

Hoek *et al.* (2013) found respiratory diseases to show the highest risk for:

- PM₁₀ (1.3%; 95% CI: 0.9-1.7%)
- PM_{2.5} (2.7%; 95% CI: 0.9-7.7%)
- O₃ (0.8%; 95% CI = 0.2%, 2.3%)

whereas cardiovascular diseases demonstrated highest risk for:

- SO₂ (1.1%; 95% CI: 0.8-1.6%)
- NO₂ (1.6%; 95% CI: 1.2-2.2%)

3.4 Limited access to green space, recreation and leisure

Evidence suggests that green space confers numerous health benefits

There is a strong and growing evidence base in support of the health benefits of green space. One direct pathway to health benefits comes from the extent to which natural and green areas promote health due to the opportunities for physical activity. In addition, there is evidence that exercising in a green environment may provide additional health benefits compared to exercising in an indoor gym environment. Public green spaces have also been associated with social interaction, which can contribute towards improved well-being, notably through improved mental health. Other benefits may come from

³ The subscripts of 2.5 and 10 refer to the fineness of these particulate matters – their diameters in micrometres (0.001 millimetres).

⁴ And this is in addition to any other effects of road transport in such areas, including perceptions of safety and risks of social exclusion/isolation.

exposure to sunlight (thought to counteract seasonal affective disorder, and by providing vitamin D); and exposure to a range of micro-organisms, including bacteria, protozoa and helminths, which are abundant in nature and may be important for the development of the immune system and for regulation of inflammatory responses.

Access to green space can be measured as either the proportion of green space within a certain distance of one's place of residence or as the number of parks or green spaces accessible nearby.

Quantitative evidence for the association between green space and health outcomes comes from a recent high-quality systematic review and meta-analysis (Twohig-Bennett and Jones, 2018). This provides strong evidence for a range of health outcomes due to green space exposure notably reduced risks of:

- all-cause mortality: 0.69 (95% CI: 0.55-0.87)
- type 2 diabetes: 0.72 (95% CI: 0.61-0.85)
- cardiovascular mortality: 0.84 (95% CI: 0.76-0.93)

as well as a range of cardiovascular and other risk factors.

A 2019 study from Australia found that the proportion of green space within a 1-mile (1.6-km) radius of one's place of residence is associated with significantly reduced risk of psychosocial distress (Astell-Burt & Fend, 2019). This same study also found that the proportion of tree canopy cover (a subset of green space) within a 1-mile radius of place of residence is associated with a lower risk of self-reporting fair or poor general health on a survey (*ibid*).

Additionally, a study in London found that living within 300m of green space has statistically significant wellbeing impacts. These are measured in 'Happiness', 'Life satisfaction' and 'Sense of worth', and depend on the area of accessible green space (Houlden *et al.*, 2018).

This strong evidence for the association between green space exposure and health outcomes can be used for modelling purposes if the challenge is overcome of finding measures for green space exposure and use that can be related to transport interventions (rather than simply green space proximity). We were unable to find such evidence, but we did find data that would support such analysis if the evidence were to be found (see Section 4.4 and the supplementary impact framework tables)

3.5 Noise pollution

Noise generates stress which can lead to both physical and mental ill-health

Traffic noise exposure is linked to cardiovascular diseases such as arterial hypertension, myocardial infarction, and stroke. Chronic low levels of noise can cause disturbances of activity, sleep, and communication, which can trigger a number of emotional responses, including annoyance and subsequent stress. In turn, chronic stress is associated with cardiovascular risk factors such as increased blood pressure and dyslipidaemia⁵, increased blood viscosity and blood glucose, and activation of blood clotting factors.

⁵ A broad term describing a number of conditions in which disturbances in fat metabolism lead to changes in the concentrations of lipids (e.g. triglycerides, cholesterol and/or fat phospholipids) in the blood and which is a risk factor for the development of cardiovascular disease.

Persistent chronic noise exposure increases the risk of cardiometabolic diseases, including arterial hypertension, coronary artery disease, diabetes mellitus type 2, and stroke (Münzel, Sørensen *et al.*, 2018).

Quantitative evidence is provided by a range of sources, many of which were associated with the 2018 WHO noise guidelines. Babisch (2018), in a meta-analysis on the relationship between road traffic noise and coronary heart disease, found that the risk of coronary heart disease increased by 8% for each additional increment of 10 decibels (dB) of road traffic noise between 55dB and 75dB. A similar meta-analysis on the relationship between road traffic noise and hypertension found the risk of hypertension increase by 3.4% for each additional 5dB of road traffic noise between 45dB to 75dB (van Kempen & Babisch, 2012). A 2017 study with data from Germany found a relationship between both road and rail traffic noise and depression, with the relationship being linear for road traffic noise and u-shaped for rail traffic noise, likely because of the small subset of sample households exposed to higher levels of rail traffic noise (Seidler *et al.*, 2017).

3.6 Severance

While the relationship between transport and severance is recognised, evidence on the precise health effects is less clear

Community severance occurs where speed and volume of road traffic inhibit access to goods, services, or people. This can occur directly (i.e. through an inability to cross busy roads) or due to reduced perceptions of safety. There is evidence that strong social networks are associated with healthy behaviours and improved health, with high levels of social integration associated with reduced mortality (with an effect size of similar magnitude to stopping smoking) (Mindell and Karlsen, 2012). However, the evidence for a direct quantifiable relationship between transport-related severance and outcomes in terms of either health or social networks has not been established. Vaughan *et al.* (2020) state that “Many publications assert that community severance affects health; while plausible, no study has examined this explicitly”. Mindell and Karlsen (2012) provide an excellent overview of the topic, concluding that ‘there is empirical evidence that traffic speed and volume reduces physical activity, social contacts, children’s play, and access to goods and services. However, no studies have investigated mental or physical health outcomes in relation to community severance. While not designed specifically to do so, recent developments in road design may also ameliorate community severance.’

There is little or no quantitative evidence to describe the relationship between severance and health outcomes. However, Ancaes *et al.* (2016) provide an interesting overview of how to value severance, which may be useful for modelling purposes. This includes ideas for measures of severance including ‘crossability’: how easy it is to cross a barrier (such as a road)?; ‘walkability’: Does the barrier reduce the ability to walk around an area?; ‘accessibility’: Does the barrier prevent people from reaching certain destinations?; and ‘quality’: Does the barrier reduce the quality of the walking experience?.

3.7 User experience

The evidence emphasises differences in experience by mode...

The primary function of transport is to reach a destination. However, the experience of the journey can differ between modes of transport: people in cars; on buses; or walking and cycling experience the same journey quite differently. There is good evidence linking travel mode choice to mental health and subjective wellbeing, particularly in the case of journeys for work, with car travel shown to be a significant contributor to user stress and anxiety, compared to active travel or public transport use. Shorter travel times in general improve wellbeing, with commutes lasting between 60 and 90 minutes having the biggest negative impact on wellbeing (Office for National Statistics, 2014).

The strongest quantitative evidence was found between active travel (walking and cycling) and psychological wellbeing. Martin *et al.* (2014) found significant associations between overall psychological wellbeing and:

- 1 active travel (0.185; 95% CI: 0.048-0.321) and public transport (0.195; 95% CI: 0.035-0.355) when compared to car travel
- 2 time spent (per 10-minute change) walking (0.083; 95% CI: 0.003-0.163) and driving (-0.033; 95% CI: -0.064 to -0.001)
- 3 switching from car travel to active travel (0.479; 95% CI: 0.199-0.758)

...but some conflict about a statistically significant relationship with depression

However, ascribing an economic value to overall psychological wellbeing is challenging. Incidence of depression is more amenable to valuation (as it is associated with high financial burden to the NHS and society) but quantitative evidence for an association with transport is conflicting: Marques *et al.* (2020) found two studies that related active travel to depression but five studies that found no significant association.

3.8 Limited access to healthcare facilities

Research has tended to focus on healthcare access, rather than outcomes

Variations in access to health services are clearly likely to be associated with health outcomes, particularly access to GPs, pharmacies, and hospitals. A number of studies explore variations in access to healthcare, but these are usually based on the assumption that this is associated with health outcomes i.e., the positive benefit is taken as given, rather than examined/quantified. Direct review-level evidence is rare: one review explored rates of heart disease and stroke mortality related to geographical location of healthcare services (in the USA) and found unequal access and unequal health outcomes for many priority populations (by ethnic origin; gender and geographical region). It is unclear if this can be applied to the UK's health system. Access to healthcare (and other services) is also likely to be related to socioeconomic status, especially due to socioeconomic patterning of car ownership (half of all people in the lowest income quintile do not have access to a car).

3.9 Limited access to high-quality employment

Similarly, employment is understood as beneficial for health but the link from transport to health is little explored

Access to high-quality employment raises similar issues to access to healthcare: there is evidence from a wide range of sources (including systematic reviews) that links employment to positive health outcomes. For example, van der Noordt *et al.* (2014) conclude that 'employment is beneficial for health, particularly for depression and general mental health' while Hergenrather *et al.* (2015) state that 'unemployment and job loss were associated with poorer physical health. Employment and re-employment were associated with better physical health.' Other studies investigate links between the transport system and access to employment, reporting socioeconomic inequalities in access. However, there are no reviews that look at the direct quantitative relations between transport-related access to employment and health outcomes.

3.10 Environment quality

Intuitively, environment quality should have some bearing on health and wellbeing, but the literature remains quite sparse

It could reasonably be assumed that the nature and quality of the built environment has an influence on health through a number of mechanisms, notably: improvements to mental health and wellbeing (as discussed in the green space section); loss of green space due to road (and car park) building; providing environments for social interaction; or enabling active travel. It is only the last of these aspects that has been studied extensively: there is strong evidence for the influence that the nature of the built and natural environment has on rates of walking and cycling. For example, Van Cauwenberg (2011) shows the impact on walking and cycling of a wide range of factors including: walkability; residential density; land-use mix; presence of shops; access to services; walking and cycling facilities. However, there is no review that relates these components to quantifiable health outcomes.

4 Impact framework

This section sets out the approach to operationalising the evidence from the previous chapter. Covering each of the ten impacts in turn, we first outline the main findings of the evidence, and to which health outcomes they pertain, then include a discussion on how these may be used in modelling, the methodological and operational challenges and considerations in doing so, and the data requirements and data gaps that a modeller would face.

For the impacts that we have modelled in Chapter 5, we outline the reasons for our choices here: why we favoured using particular parts of the evidence to exemplify analysis over others. Often this is linked to data availability but in some cases, relates to selecting evidence that better conveys a range of approaches. For the impacts that we did not model we outline the evidence and/or data gaps that prevented this.

4.1 Physical inactivity

Physical activity is beneficial for health and fitness

The evidence is comprehensive and strongly supportive of physical activity being beneficial for health. Limited opportunities to engage in physical activity as a consequence of transport impediments is therefore an area that planning policy can add value by addressing.

The impact framework table for physical inactivity is shown as a sheet in the supplementary workbook, and summarises the evidence on impacts from the literature distinguishing, respectively, upstream causes (here, factors that influence the amount of physical activity people engage in, or their likelihood of engaging) from downstream impacts (the health outcomes of physical activity). The tables also summarise the data that would be needed to model these impacts ('Data requirements') alongside our assessment of which data are currently available for the current purpose ('Available data'). Within the evidence shown, there are systematic reviews which cite multiple studies and coefficients that could be used for modelling.

There is strong evidence of physical activity's beneficial effects on a range of health outcomes

Physical inactivity is judged to have Tier 1 evidence by our assessment framework (from Chapter 3). As is apparent from the supplementary impact framework table, there is strong evidence of physical activity's positive effects on mortality, obesity, fitness, and cardiovascular risk factors. The upstream evidence for physical activity is of three main types: proximity – or in some cases access – to infrastructure or places where physical activity takes place, such as green space or cycling tracks; the qualities of such infrastructure, such as safety and comfort; and interventions to encourage use, such as bike-share programs. The downstream evidence could be described as quantifying the numerous health benefits that come about as a direct effect of exercise.

Modelling is a two-stage approach with upstream causes and downstream outcomes

The approach to modelling impacts of interventions to encourage physical activity depends on the intervention but in most cases should include:

For the upstream:

- A buffer zone around the intervention. This buffer zone may be a simple straight-line boundary (Sallis *et al.*, 2016), or may require modelling of

access to the infrastructure via roads or footpaths (Goodman *et al.*, 2014), or neighbourhoods included in a program (Fuller *et al.*, 2013).

- Incorporating measures of the quality of the intervention, such as safety and comfort.
- Controlling for factors such as existing similar infrastructure. For example, attempting to isolate the health impacts of a stretch of active mode infrastructure without capturing the effects of other nearby infrastructure. (this is not covered in the impact framework)
- Translating the coefficients of likelihood of use, and/or amount of use into a dose to align with the downstream impacts.

For the downstream:

- Selecting health outcomes of interest and determining metrics that both align with the upstream and downstream coefficients and for which there are data.
- Quantifying the impact by calculating the number of residents within the affected zone(s), perhaps tightening the focus by also including prevalence of health conditions of interest in the affected area.

Challenges arise in aligning upstream and downstream coefficients

The evidence is more robust for the downstream effects, with more systematic reviews and clearer dose-response coefficients. While the upstream evidence is amenable to modelling, the challenge lies in aligning the coefficients of the upstream and downstream. For example, an increased number of minutes of physical activity or a proportional increase in physical activity needs to be translated into the metric used for downstream impacts, such as MET hours of cycling. Where outcomes fall into discrete ranges, such as 11.25 MET hours cited in Kelly *et al.* (2014), these ranges may be too wide to capture variation in the upstream effect (a constraint of the available data), meaning the granularity of existing data make it difficult to apply the evidence (which is robust) to the available data. This is mentioned in the analysis in Section 5.1.

Data gaps and challenges

Existing data on cycling infrastructure supports the basics of the upstream approach, but only the Greater Manchester cycling data has sufficient detail to incorporate infrastructure qualities, such as degree of segregation of cycling paths, and this is not to the level of detail cited in the evidence. Data on health outcomes are available from Fingertips and, in some cases ONS, but only go to the level of geographical detail of local authorities. The ideal infrastructure data for modelling the upstream would be similar to the Greater Manchester cycling infrastructure data but cover the whole North of England and would go beyond it in showing degree of safety of the lanes: segregation, smoothness, indications to traffic of separateness, and how far this is enforced. Additional evidence would further focus on people's preferences to use cycling infrastructure based on these qualities.

Additional evidence that either expressed health outcomes in smaller bin widths (the bin width was 11.25 MET. Hours in Kelly *et al.* (2014)) or that incorporated a larger number of coefficients to predict more accurately a larger total amount of physical exercise (so the outcome size was large enough to span several bins) would also improve estimation.

Evidence for analysis

The strongest evidence on the health outcomes of physical activity can be found in:

- Kelly *et al.* (2014): Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship
- Zheng *et al.* (2009): A meta-analysis quantifying the dose-response of walking in reducing coronary heart disease risk
- Mueller *et al.* (2015): A systematic review - health impact assessment of active transportation

All of these studies have high methodological robustness and are amenable to modelling health outcome for a given amount/change in physical activity. However, these are downstream effects. For our analysis in Section 5.1, we also wanted to convey the upstream – the change in physical activity that would result from an environmental stimulus. For this we used:

- Goodman *et al.* (2014): A study measuring increased physical activity following the construction of active mode infrastructure in the UK
- Sallis *et al.* (2016), as cited in the systematic review by Gianfredi *et al.* (2021): A study assessing increased physical activity based on proximity to green space

These are not systematic reviews but have the advantage of quantifying upstream causal drivers of physical activity, which is useful for GIS modelling.

The first paper, Goodman *et al.* (2014), estimates the change in physical activity (walking and cycling) that results from newly-built infrastructure that pedestrians and cyclists can use for transport and leisure travel, and expresses its results in the form of coefficients that are amenable to spatial modelling against existing or planned infrastructure.

The second, Sallis *et al.* (2016), found that the density of parks near residences in urban areas is linearly associated with an increase in moderate to vigorous physical activity (MVPA).

We chose these two papers because of the availability of data and because they effectively convey some different approaches that have broader applicability for similar analysis: proximity to infrastructure and proportion of green space in a neighbourhood.

4.2 Incidents and safety

Road traffic incidents cause huge loss of life worldwide

The literature review cites statistics on how extensive are deaths and injuries globally from road traffic incidents (RTIs). The UK has one of the lowest rates of deaths from RTIs in the developed world. But variations exist between areas and, given the devastating impacts of RTAs, further insight into the causes and how to mitigate them is warranted.

The impact framework table for incidents and safety is shown as a sheet in the supplementary workbook and summarises the upstream and downstream evidence respectively. Here the upstream evidence concerns those factors affecting the risk of an RTI while the downstream evidence concerns the impacts of accidents in terms of mortality (including demographics) and physical and mental health impacts.

Speed, volume, density, and regulations affect crash likelihoods

The upstream evidence in the supplementary impact framework table includes systematic reviews and individual studies. The factors affecting the likelihood of a crash include traffic speed measures, traffic volume, and interventions such as speed cameras and traffic calming regulations. They also include coefficients that connect directly to outcomes, such as: speed increases the likelihood of a *fatal* crash (rather than increases the chances of a crash, combined with a separate coefficient for the chances of mortality from a crash). Downstream impacts in the supplementary impact framework table are not in the form of ‘dose-response’ coefficients as much as for the other impacts.⁶ They include the prevalence of incidents, baseline mortality rates, the proportion of pedestrians involved, and mental health impacts from crashes.

Crash prediction is complex and should be approached with caution.....

The upstream evidence on this impact includes coefficients on speed, density, and volume. But crash forecasting is complex and more involved than isolated coefficients might suggest. Causal factors in crashes are numerous and arise from factors including behavioural, vehicle-specific, traffic conditions, road geometry, and weather conditions. Of these, behavioural factors are thought to be most important but are least amenable to data collection (Roshandel *et al.*, 2015). Data are readily available on traffic conditions and a focus in the literature has been on which combination of traffic conditions are more crash prone (*ibid*). The traffic-based coefficients cited in this impact framework should therefore be contextualised as ‘other things equal’, and used to model changes in that upstream variable in isolation rather than as part of a multi-coefficient model with multiple and possibly interacting effects. Such a full prediction model would be more in the realm of specialists and beyond the scope of this work (to consider existing evidence as it might apply to the North).

...further research is needed for a comprehensive approach

Because the risks of road traffic crashes are highly context-specific, forecasting them using available evidence and data with any accuracy is quite challenging. A modeller would first need to be cognisant of the limits of any forecast. They might then proceed by forecasting likelihood of a crash perhaps using isolated upstream coefficients, such as traffic density, and frame estimations in the form of “Were density to reduce by x%, other things equal, we would expect the likelihood of a crash to reduce by y%”. A more robust

⁶ That is, where the dependent variable changes by a number of units in response to a change in the independent variable.

approach would be to develop a multivariate crash forecasting model using multiple upstream coefficients, such as traffic speed combined with traffic volume, but further research would be needed to achieve this, as we did not find such a complete model in the evidence. Both approaches should note the previously stated caveats, that crashes are highly context-specific and traffic characteristics are only part of the picture.

With the isolated or a multivariate model, analysis could be done in a given population of traffic and based on upstream coefficients such as traffic characteristics (speed, volume etc). It could in principle forecast crash numbers in a given period. Some of the upstream evidence on traffic regulation, such as speed cameras or traffic calming zones, could enter this model since they affect speed, which is a crash predictor. The model could then forecast health outcomes by multiplying crash likelihood by a scalar such as the rate of mortality or injury, such coefficients being available in, for example, Ang *et al* (2017) or the rates of mental health impacts, such as those in Craig *et al*. (2016), to estimate likely incidences of injury, mortality, and/or mental health impacts due to RTAs. The evidence from Hussain *et al* (2019) would could be used here (since it relates to impact speed, which presupposes a crash has already occurred) as a predictor of the *severity* of a crash.

Evidence for analysis

The strongest evidence on incidents and safety can be found in:

- Hussain *et al*. (2019): A systematic review and meta-analysis on the relationship between impact speed and the probability of pedestrian fatality during a vehicle-pedestrian crash
- Charters *et al*. (2017): A systematic review on population incidence of pedestrian traffic injury in high-income countries
- Roshandel *et al*. (2015): A systematic review providing a summary impact of traffic characteristics on crash occurrence

The first two of these are rated as robust and useful. However, the nature of the evidence makes it difficult to relate the estimates to readily available data. For example, we could not obtain data on impact speed which could have been used in the first of these studies or pedestrian patterns which could have been used in the first two of these studies.

We subsequently identified the third study, which reported results relating to traffic volume, which is an input into crash likelihood estimation, though one of many, and not the most important one (which is thought to be behavioural characteristics).

Our approach then, by necessity, was to be more descriptive, and show accident data around traffic volume, to allow visual comparison, rather than demonstrating cause-effect quantification.

Data gaps and challenges

Data exist for traffic volume and speed throughout the UK, but these are point data, rather than area data for specific roads or sections of roads. It is challenging to obtain from these variables such as traffic density (which would

need volume to be combined with space, which is not possible for point data). Data which show the incidence and type incidents for a given area tend to cover fairly broad geographical areas, for example, number of fatal or serious incidents within Liverpool. There are some data at LSOA level, but only for London. We also located more detailed data for Greater Manchester for individual incidents. These are ‘point’ data – showing the location on a map of individual incidents, as opposed to area data that might show the average number of incidents in an area.

4.3 Air pollution

Air pollution is a major contributor to premature deaths and illnesses

Air pollution is a major contributor to mortality, hospitalisation, and health conditions such as asthma. Of particular danger are fine particulates such as PM_{2.5} and PM₁₀

The impact framework table for air pollution is shown as a sheet in the supplementary workbook, and summarises the downstream evidence, the health impacts of pollutants. The evidence review did not uncover upstream causal drivers of air pollutants. Subsequent scoping (not being robust enough to be listed in the impact framework) suggests this includes such factors as traffic volume, weather conditions, and topography.

The downstream evidence is detailed and amenable to modelling

The evidence is more extensive, and amenable to modelling because it is in dose-response form, in the downstream impacts in the impact framework table. Here the increased risks of mortality, hospitalisation, or health conditions are expressed for individual pollutants and as continuous coefficients.

Modelling impacts is straightforward for the downstream

The downstream health impacts are well documented and robust, including reviews and epidemiological studies, while spatial data exist for each of the most important pollutants covering the whole UK. A straightforward methodology is to clip these spatial data to areas of interest and overlay onto population data, translating likelihoods of impacts of interest into headcounts i.e. areas in which large number of people coincide with areas of high pollution (health risk). At its most detailed, the approach could use finely-grained population data (well below typical area-based datasets) to account for how populations are distributed around pollutant hotspots. A further refinement might display the prevalence of the health outcomes caused by pollutants in affected populations, such as asthma or cardio-respiratory diseases. The most detailed population data available from TfN is in point form and combining this with the point data on pollutants would shed (detailed) light on the burden of transport-related health impacts.

It would be more challenging to predict the upstream causes of air pollution, for example to assess the effects of a transport intervention on pollution. Our systematic evidence review did not uncover upstream causes, but subsequent searches suggest this is more of a specialist field, where modelling would necessitate controls such as weather, vehicle type, geometry of the area, and thus require data and evidence beyond the scope of this project (but which may be possible in TfN’s existing models and other programmes of work).

Data gaps and challenges

Point data on emissions from Defra in vector format are available for all of the pollutants discussed in the supplementary table and have sufficiently detailed coverage to resemble area data when formatted appropriately. But, and as the

principal limitation, these are total emissions (including from non-transport sources) and do not identify the source of these emissions. That is, the available data do not clearly identify which emissions are from transport and which are not. As an alternative, coarser data are available from BEIS which do identify sources of emissions, but these are either in raster files, which do not have the geographical resolution of the aforementioned point data, or in shapefiles which show emissions only from single site sources, such as factories, rather than as emissions covering an area. This would, however, come at a loss of resolution that may not be so desirable given the location-specific nature of air pollutants and the importance of understanding them at a localised level.

Evidence for analysis

The strongest evidence on the health impacts of air pollution can be found in:

- Requia *et al.* (2018): a meta analysis of increased hospitalisation and mortality risks from six pollutants (CO, NO₂, O₃, PM₁₀, PM_{2.5}, and SO₂)
- Hoek *et al.* (2013): a systematic review and meta-analysis of increased risk of cardiovascular and cardio-respiratory diseases from five pollutants (PM₁₀, PM_{2.5}, O₃, SO₂ and NO₂)

Both studies carry out meta-analyses with robust methodologies, expressing the results as dose-response coefficients which are amenable to quantitative analysis. Both studies emphasise especially particulates as a source of heightened health risk.

As well as being robust sources of evidence in themselves, the results are readily combined with available data (from Defra) on modelled point estimates of the above pollutants. These can be directly applied to the evidence above. Given the slightly greater number of pollutants covered, we opt to use the Requia *et al.* (2018) estimates in the analysis in Section 5.3.

Other evidence (mostly about increased mortality) was judged of lower usefulness owing to either weaker methodological rigour (on the evidence side) or a stronger need for source-specific data (e.g. tailpipe emissions).

4.4 Limited access to green space, recreation and leisure

Green space is beneficial for physical and mental health

A number of hypotheses exist for the relationship between health and natural spaces, including the opportunities for physical exercise which, as already noted, provide health benefits, which are increased when exercise is undertaken in natural spaces; through the opportunities for social interaction, which improve wellbeing; through exposure to sunlight and vitamin D; and the 'old friends' hypothesis of exposure to bacteria, protozoa and helminths which boost the immune system and regulate inflammation (Twohig-Bennett & Jones, 2018).

The impact framework table for limited access to green space is shown as a sheet in the supplementary workbook, and summarises the evidence on impacts from the literature distinguishing, respectively, upstream causes

(here, factors that affect access to green space) from downstream impacts (the consequences of changes in access. The tables also summarise the data that would be needed to model these impacts ('Data requirements') alongside our assessment of which data are currently available for the current purpose ('Available data'). Within the evidence shown, there are systematic reviews which cite multiple studies and coefficients that could be used for modelling.

The evidence largely concerns the link between usage and health/wellbeing

As the supplementary impact framework table shows, the downstream impacts of green space are extensive. As a health and wellbeing impact judged to have Tier 1 evidence (by our assessment framework), the stronger associations between green space exposure and health outcomes are suitable for quantitative modelling.

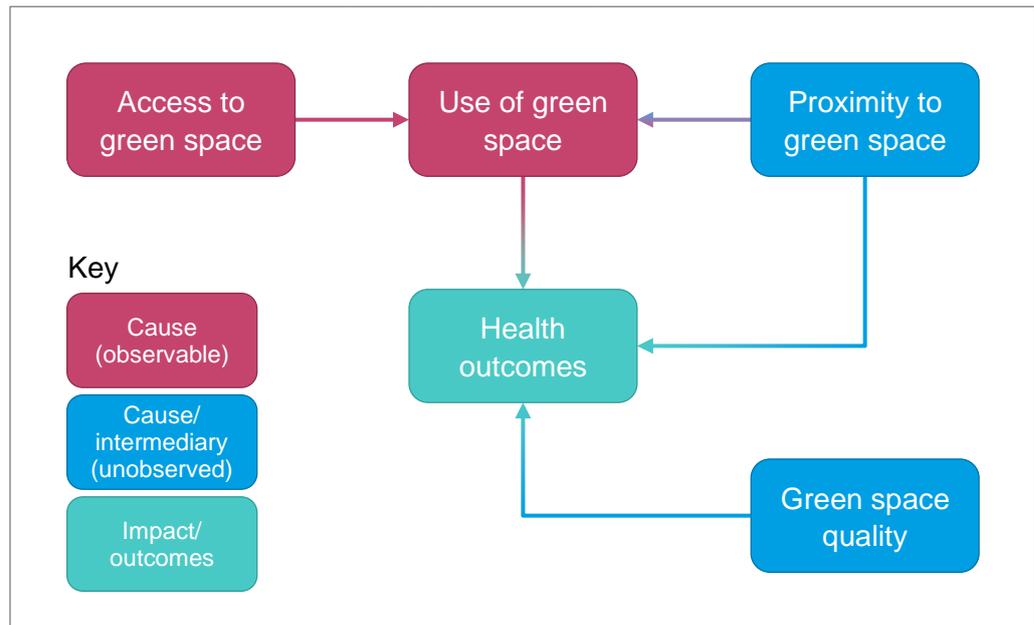
The evidence of health benefits from green space concerns three main channels: health outcomes derived from direct use, i.e. the benefits to people being in that green space; outcomes which are more passive, and which derive from proximity; and outcomes based on quality, such as 'greenness' or improvements to the green space. For transport interventions, which are likely to be more focused on improving access, modelling will mainly focus on benefits resulting from use, which will in turn be a function of access.

In some cases, proximity could serve as a surrogate for usage

The process of modelling the impacts depends on the causal channel (see Figure 4.1). Modelling proximity to health outcomes is simplest and, based on the evidence, can take one of two approaches:

- **Distance to green space:** For those measuring health impacts caused by green space being within a specified range of a dwelling, spatial data on green space combined with spatial data on household characteristics could be used. For example, a boundary representing the distance within which health impacts operate could be mapped around each green space polygon to assess health impacts of residences within that range.
- **Proportion of green space:** Some health outcomes arise due to proportions of nearby green space, for example, a quantified reduction in the risk of diabetes per percentage-point increase in green space within 1km of subjects' residences.

Figure 4.1: Causal chains of green space health impacts



The upstream data from Ordnance Survey on green space, combined with the data TfN provided on households at the MSOA level would in principle support both approaches.

Access could be inferred...

To model outcomes based on use of green space - for example, by using coefficients that show a larger impact of exercising in green space than in a gym – the focus would need to switch to modelling access to green space. This is likely to be a concern in modelling transport interventions. The Ordnance Survey green space spatial data include access points to the green space. This could be combined with TfN data both on major road networks and on household access to cars to get a picture of viable transport links to nearby green space at the household level.

Similarly, data on active mode networks, such as the cycle route network data (e.g. from Sustrans or Transport for Greater Manchester), would permit modelling of households' access to green space either on foot or by bicycle. The impact framework includes coefficients on people's relative likelihoods of walking, cycling, or driving to get to green space which could enrich such analysis.

...but converting this to usage remains challenging

After modelling access, however, a challenge will be in quantifying (or finding ways to proxy) usage. From our data assessment, there is no obvious dataset that measures such usage of green space. By extension, there are also no data on how usage might change in response to a transport or other intervention designed to improve access.

Appropriate quality measures represent a data gap at this time

Modelling quality-based impacts would require data on green space quality (however defined). Measurements used in the literature include the Normalised Difference Vegetation Index (NDVI) and proximity to greening interventions. However, we were unable to find such data as part of this exercise and this represents a data gap that TfN may wish to investigate further in the future.

Other challenges in relating the literature to factors of interest concern:

- finding measures of green space exposure and use that can be related to transport interventions, rather than simply proximity to green space
 - in the literature, such access metrics would ideally cover indicators such as walkable or drivable distance to green space
- the availability of corresponding data on health outcomes at a sufficiently detailed spatial level

Evidence for analysis

The strongest evidence on the health impacts of green space can be found in:

- Twohig-Bennett and Jones (2018): A systematic review and meta-analysis of green space exposure and health outcomes
- Yang (2021): An umbrella review - review of 40 systematic reviews – of green space and human health
- Public Health England (2020): A systematic review on improving access to green space.

There are several more strong pieces of evidence. Yet the challenge is noted in the initial evidence review of modelling, of assessing access to green space. There is also a challenge of translating access into use, for which we could not find any appropriate data.

Given these challenges, and the available data, we considered the options for GIS analysis to be related to proximity to green space (distance to green space) and green space in a neighbourhood (number of parks nearby, for example, or proportion of area that is green space).

The studies that were either in the evidence review or cited in the systematic reviews, and which both covered health outcomes of interest and which were amenable to this type of analysis were:

- Houlden *et al.* (2018): A systematic review of the positive association between green space and life satisfaction
- Astell-Burt *et al.* (2014): A study examining how the proportion of green space within 1 km of residents of an area is associated with diabetes
- Astell-Burt and Feng (2019): A study examining how the amount of green space within 1 km of an area's residents is associated with psychosocial distress

We chose Houlden *et al.* (2018) because it allowed a simple proximity measure to be used, and has the advantage of putting to the test UK and EU guidelines that individuals should have access to a green space within 300m of their home.

We chose the two Astell-Burt studies (2014 and 2019) because they relate to the proportion of nearby green space and because they cover both a well-known physical health outcome and a mental health outcome.

4.5 Noise pollution

Noise pollution can have an array of physical and mental health impacts

Noise pollution arising from traffic has been associated with a range of adverse physical health outcomes, such as hypertension, heart disease, breast cancer, and diabetes.

The impact framework table for noise pollution is shown as a sheet in the supplementary workbook, and summarises the evidence on impacts from the literature. Upstream impacts cover the factors likely to increase noise, whereas downstream impacts cover the effects on health of noise. The upstream table is much more sparsely populated which reflects the greater focus of the literature on the downstream. Upstream causes include volume and speed of local traffic, and proximity to rail lines and air routes, but predicting noise volumes from these is a specialist field – noise propagation modelling, which is a field of acoustics.

Noise beyond a threshold is associated with increasingly adverse health outcomes

The downstream impacts outlined in the supplementary tables all come from systematic reviews. They cover noise exposure from rail, road, and air noise and the aforementioned health impacts. One of the impacts considers the combination of noise from multiple sources. The evidence in this part of the impact framework is strong, with only mental health impacts seeming to still lack a strong body of evidence. The different pieces of evidence mostly share the same independent variable, decibels of noise exposure, and are thus amenable to mapping against data showing the spatial distribution of noise pollution. Most of the coefficients are continuous, describing increasingly adverse health outcomes with rising decibels, but some are discrete.

Modelling health outcomes is relatively straightforward

As with air pollution, the process of modelling impacts is relatively straightforward and would involve clipping spatial data to areas of interest and overlaying onto population data. Decibels can be translated into likelihoods of health outcomes using the coefficients from the impact framework, and population data could be overlaid onto the map to assess where these impacts fall most on the population of the North. The UK government provides data both on spatial mapping of noise, measured in decibels, and noise exposure data, with numbers of people affected by decibel levels of > 55db, > 60db, > 65db etc.

While the focus of the operational impact framework is on the effect that runs from noise (in decibels) to health impacts, we note that predicting the effects of interventions to manage noise would be more challenging e.g. a diversion of traffic intended to reduced traffic volume in noise hotspots. Specialist modelling (perhaps adapted from TfN's existing tools) would be needed to accurately forecast such effects before applying the downstream analysis here.

Aligning timespans of evidence and data is a consideration

The outcomes of this analysis are the heightened risk (i.e. the change in relation to the pre-existing risk). Were there more detailed data on pre-existing risks, it would be possible to see the overall impact on health risks.

We were unable to find data on noise pollution caused by aircraft, only that caused by road and rail. Further data searches could focus on this to be able to utilise some of the coefficients we found in the evidence. Another consideration in modelling noise impacts on health is aligning the timespans covered by the data with those used by researchers in the evidence. For

example, finding data that is the average noise over 24 hours, if that is how the coefficient is measured in the literature.

Evidence for analysis

The strongest evidence on the health impacts of noise pollution can be found in:

- Van Kempen *et al.* (2018): A systematic review and meta-analysis of the effects of environmental noise and Cardiovascular and Metabolic Effects
- Basner and McGuire (2018): A Systematic Review on Environmental Noise and Effects on Sleep
- Munzel *et al.* (2018): A comprehensive review of the effects of noise exposure on oxidative stress and cardiovascular risk

All three pieces provide evidence amenable to modelling, and may be operationalised using the road and rail noise data from the UK government, which is detailed and comprehensive.

Given the broader coverage of health outcomes, and inclusion of coefficients for combined rail and road noise, we decided to use coefficients cited in the Munzel *et al.* (2018) study in the noise pollution analysis in Section 0, to better convey the range of modelling approaches that may be used. Of these, we found Babisch (2014), covering coronary heart disease from road noise; van Kempen *et al.* (2018) and Babisch (2012), covering hypertension from road noise; and Seidler *et al.* (2017), covering depression from road and rail noise, to be most useful in exemplifying the different approaches one might take to modelling noise pollution.

But the other studies are robust and highly amenable to modelling, and with scalable approaches being now demonstrated in the analysis section, could be used in analysis in the same way as we have done for these three studies.

4.6 Severance

Severance concerns a range of effects and, following Mindell and Karlsen (2012), community severance describes barriers that can impede access to active travel or free movement of people to visit friends and family in their nearby areas. The barriers in question result from transport infrastructure, such as large motorways. Especially for older people or children, such barriers can be very challenging to cross and, if they lie across the routes between people, can disrupt people's social connections.

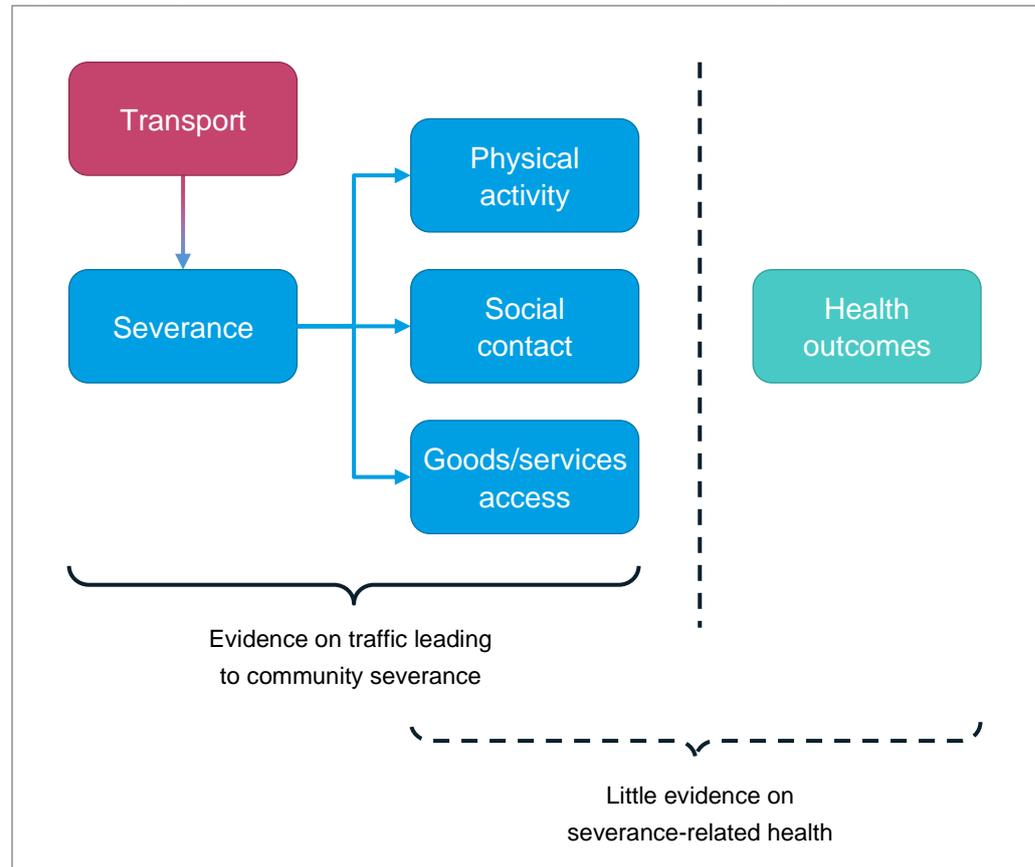
The impact framework table for severance is shown as a sheet in the supplementary workbook, and summarises, respectively, evidence for the upstream causes and downstream impacts of severance. The upstream coefficients outline the ways that social connections and green space visitation may be affected by walkability, traffic volume, and perceptions of safety. The downstream impacts outline the ways in which social capital or social isolation can affect physical and mental health outcomes.

Transport infrastructure can sever people from friends and family

There is a lack of evidence linking transport to health outcomes due to severance

As an impact with tier 2 evidence by our assessment framework, there is some quantitative information on the effects of severance. However, there are also one or more gaps/limitations that limit the degree to which a robust quantitative assessment can be made. In this case, the problem is one of linking upstream (factors leading to severance) to downstream (health outcomes caused by such severance) (see Figure 4.2).

Figure 4.2: Logic of, and evidence for, health impacts of community severance



The evidence suggests that traffic volume and speed interfere with normal activities while other evidence suggests that reduced access to social contact and goods and services is detrimental to health. The link that has not been formally established (however likely it seems), is between community severance by roads and traffic directly and adversely affecting health and wellbeing in a direct manner (Mindell & Karlsen, 2012).

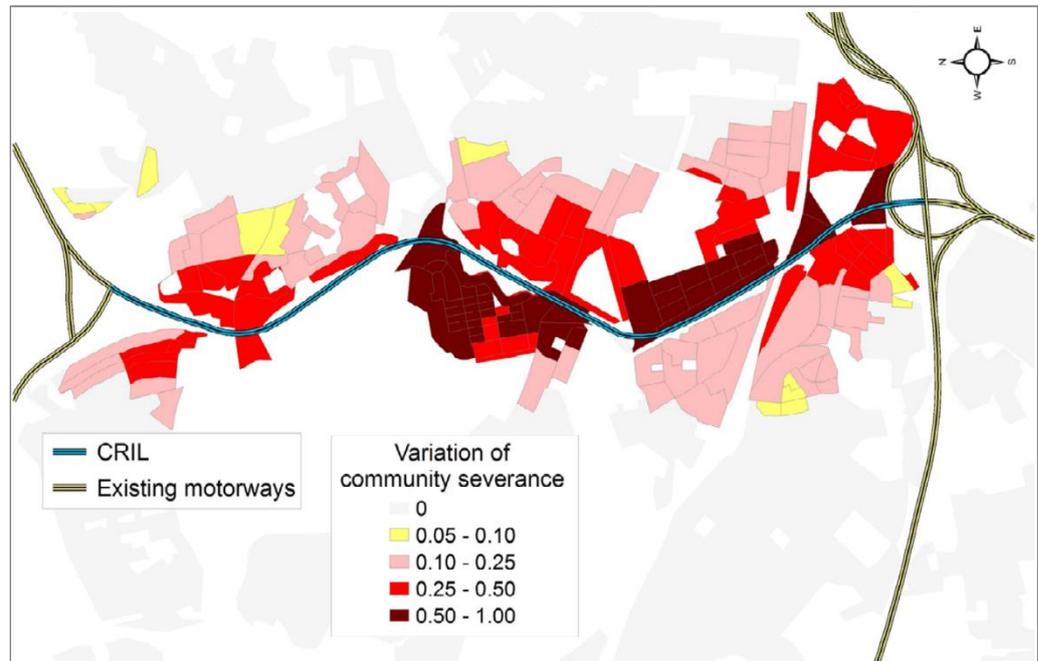
Modelling severance remains a challenge but there may be ways to infer social connectedness

While there is an evidence gap between transport and severance-related health impacts, TfN was keen to explore options for advancing the analysis all the same. One option for doing so would be to follow a method put forward by Anciaes (2013).⁷ In that paper, Anciaes (2013) identifies all potential destinations in walking distance of a neighbourhood, assigning an attractiveness score to each weighted by population. Severance can then be assessed by identifying the destinations that lie beyond (are severed by) a road. Extensions of the method could then adjust for the severity of the barrier e.g. availability of crossing point, traffic speed, traffic volume etc. Carried out on a neighbourhood-by-neighbourhood basis would yield a map such as

⁷ This paper uses the example of a ring road in Lisbon to demonstrate the approach.

Figure 4.3, showing how access to (in principle) walkable destinations may be impeded by a road.

Figure 4.3: Severance effects of a section of road



Source(s): (Anciaes, 2013).

Data gaps and challenges

The challenge of Anciaes's (2013) method is that it requires values for attractiveness (with population proposed as a proxy) and, in principle, methods for (numerically) specifying the severity of a barrier represented by a road. Currently, there seems to be relatively little in the way of evidence with which to derive such values e.g. to feature in a quantitative (maybe even cost-benefit) analysis. This would typically require new research to quantify non-monetary benefits e.g. from stated preference surveys to develop willingness-to-pay metrics.⁸ Also, the problem would still remain of then translating that lost access to physical and mental health outcomes. Linking the outputs of such a method to the literature requires a common unit which is not straightforward or settled, as the supplementary impact framework table shows (in part because of the challenges of measuring the phenomena of interest).

A tentative approach

Nevertheless, and subject to various caveats, the style of analysis put forward by Anciaes (2013) may be possible in a simpler form, based purely on population data.

Using detailed population data (e.g. postcode-level data), and interpreting a postcode as a neighbourhood, it is possible to identify the population in walking distance of said postcode as a group of potential (rather than actual/observed) social connections. If a road passes through this walkable area, the population can then be divided into two, giving a percentage of

⁸ Anciaes (2016) does, however, cite a few other studies that show, for example, that land prices tend to be lower in areas next to elevated railways than areas next to underground ones (Lee and Sohn, 2014); and that land value premiums rose following the tearing down of a freeway and replacing it with a linear park (Kang and Cervero, 2009). However, another study found speed bumps to not significantly affect property prices (Bretherton et al, 2000). There is thus some suggestion of monetisable effects but this was beyond the scope of this current study.

potential social connections severed. Were one willing to interpret these potential social connections as some crude measure of social capital, such higher severance could be thought of as being a risk factor for worse health outcomes.

We apply this method to a test case in Section 5.6, where we also discuss the relative merits in more detail.

Evidence for analysis

A recurring finding in the literature is that community severance cannot yet be effectively quantified. Boniface *et al.* (2015) also find that ‘There are relations between severance and both social capital and social cohesion, but no quantifiable relations were identified’.

Nor did the initial evidence review uncover quantitative evidence that is of direct use for modelling. As such, it was not possible to perform analysis for severance in the same way as was done for the preceding impacts.

But, since this is an area of interest, we proceeded with testing an experimental approach outlined in Ancaes (2013), which articulates a methodology that transport planners might seek to develop. This approach was supported by data obtained on population and on local area geographical features (roads, neighbourhoods).

A strong caveat should be noted that this approach is nascent, and would require substantial additional research and development before being ready to be operationalised in a meaningful way.

4.7 User experience

The experience of a mode of travel can have mental health impacts

The experience of travel can differ depending on the mode, and this in turn can affect the traveller’s health and wellbeing.

User experience is classed as Tier 2 for its amenability for quantitative modelling, meaning either the data were insufficiently comprehensive, or econometric results were not strong enough, for this to be characterised as a robust result. In this case, evidence is sparse. The distinction between upstream and downstream for the obtained evidence is less clear, with stress shown as both a cause and effect of improved user experience in the system map in Appendix A.

The strongest quantitative evidence was found for active travel (walking and cycling) and psychological wellbeing. Data on mode of travel and wellbeing may be challenging to obtain

The downstream impacts include positive associations between active travel and wellbeing indicators. The strongest quantitative association was found between active travel and psychological wellbeing. Impacts on depression have conflicting evidence: in the systematic review cited, some studies found an effect and others did not, while in another systematic review, the strongest evidence was for effects on depression. Associations between travel by car and wellbeing were negative in one panel study.

The challenges in modelling user experience are manifold. Firstly, the data we found on model of travel is at a fairly broad geographical level and does not have continuous data on time spent in particular forms, but rather discrete bins of travel time by type. Data on the outcome variables may be available from Fingertips or ONS but metrics such as wellbeing, the outcome for which

the strongest associations were found, may be harder to find, particularly at a fine level of geographical detail.

Data requirements for future analysis

The literature found during the evidence review and the available data did not suggest that this impact would be conducive to modelling at this time: the evidence was weak to moderate in strength and the data on modes of transport was at an overly broad geographical scale.

Were stronger evidence to emerge, data acquisition efforts should focus on access to public transport, on modes of travel at a detailed (LSOA or lower) level, and on time spent in particular modes of travel.

4.8 Limited access to healthcare facilities

Variations in access to healthcare are likely to be associated with varying health outcomes

Variations exist in people’s ability to access healthcare services, and this is likely to affect health outcomes. Access to healthcare is classed as tier 3 for its amenability for quantitative modelling, meaning that although evidence may exist, quantification is limited. The impact framework table for limited access to healthcare is shown as a sheet in the supplementary workbook, and summarises the evidence on impacts from the literature. Car availability and public transport provision are the two upstream causes for which we have evidence, but these are single studies, one of which is descriptive and of little use in modelling. These are included more to demonstrate the paucity of evidence than for their usefulness. The downstream evidence covers the differential access to health services and its estimated impact on heart disease and stroke mortality but does not contain usable coefficients.

Evidence and data are limited

Modelling access to healthcare will be challenging. The evidence does not link access to health services with health outcomes. A modeller could make the very reasonable assumption that access improves outcomes but could not quantify this based on the available evidence. Furthermore, modelling access could be challenging. Data is available on access to cars but we found less on public transport provision. Data on access to healthcare services are limited. The upstream evidence has only one quantitative coefficient, and this from a single study. The downstream evidence has none.

Data requirements for future analysis

The literature found during the evidence review and the available data did not suggest that this impact would be conducive to modelling at this time.

The single piece of evidence found was weak and thus not suitable for modelling. We did not find useable data on access to healthcare facilities.

Were stronger evidence to emerge along the lines of the existing evidence, data acquisition should focus on geographically detailed data on access to GP services, including distance, accessibility by different modes of transport, and ease of using the services. To assess differences in accessing services for particular ethnic groups, as in this study, or to compare differences in access along such lines, the population data would need to include information about ethnicity. This is not available at a very detailed geographical level.

4.9 Limited access to high-quality employment

Variations in access to employment are thought to have health outcomes, but this is not quantified

Evidence is insufficient for modelling

The evidence suggests that employment is beneficial for health. And where access to employment is limited by transport, this is a potential policy issue. However, at present, the evidence is insufficient to inform such interventions. Access to employment is classed as Tier 3 for its amenability for quantitative modelling, meaning that although evidence may exist, quantification is limited. Single study results are available for the upstream discussing how access to car or public transport can affect access to employment. While downstream evidence links employment to depression and mental health.

As already noted in the literature review, there are no reviews that look at the direct quantitative relations between transport-related access to employment and health outcomes. Robust, usable coefficients are thus unavailable.

Data requirements for future analysis

The literature found during the evidence review and the available data did not suggest that this impact would be conducive to modelling at this time: the supplementary tables show that evidence found during the review was rejected.

To model access to employment by car or public transport, data would be needed on access to cars, public transport availability, as well as, for a given neighbourhood of interest, the nearest locations of employment, which would include spatial data on business locations, the size of their workforces, and rates of hiring.

This could give a picture of the state of nearby labour markets and the strength of access. However, one should be aware of endogeneity issues in this approach: hiring activity is likely to be influenced by available applicants, and this will be influenced by access, if the hypothesis is correct. So comparisons with areas that have similar economies, but improved access, might be employed to overcome this.

If this were combined with data on unemployment and on the underlying health outcomes these (rejected) papers suggest are linked to employment, then a detailed picture could be drawn of where public transport interventions might have the most impact in increasing employment access and by addressing health problems in doing so.

4.10 Environment quality

There are good reasons to think the built environment affects health and wellbeing but the available evidence does not (currently) support quantification

It is reasonable to assume that features of the built environment, such as walkability residential density; land-use mix; presence of shops; access to services; walking and cycling facilities would influence health outcomes. Yet as noted in the literature review, this has not been quantified. Environment quality is thus classed as Tier 3 for its amenability for quantitative modelling. We did not find upstream evidence for environment quality. Downstream impacts of the built environment concern in particular how it encourages physical activity. This is a separate issue, discussed earlier in this impact framework, and for which plentiful evidence and data exists. But not health outcomes are quantified. Given this, it would not be possible to model health outcomes due to environment quality using currently available evidence.

Data requirements for future analysis

The combination of the evidence uncovered in the systematic review of evidence and the available data did not show itself to be conducive to modelling. The two pieces of evidence were rated as 1 out of 5 for usefulness in modelling. The evidence did not cite quantitative coefficients that one could link to a particular data requirement.

Stronger evidence would be needed on this impact to support modelling and would need to have clear quantitative coefficients to identify a data requirement.

5 Analysis

This chapter presents the analysis and results of the geospatial modelling

This chapter presents the analysis and the results of the geospatial modelling, considering both the upstream and downstream health impacts set out in the previous chapters.

The analysis focuses the six impacts considered feasible for further quantitative analysis:

- 1 physical inactivity
- 2 incidents and safety
- 3 air pollution
- 4 limited access to green space, recreation and leisure
- 5 noise pollution
- 6 severance

In approach, the analysis takes upstream factors identified in the impact framework (where there are suitable data) and applies coefficients from the available evidence to first assess the spatial distribution of health effects e.g. areas in which air pollution is high, translating to heightened health risks. As appropriate, health impacts are then estimated by overlaying the above with data on the spatial distribution of the population. For example, while there may be equally high air pollution in two areas (a similar *effect*), the *impact* will be greater in whichever area has the greater population.

Population impacts for noise pollution, greenspace (wellbeing) and physical inactivity are calculated using the LSOA population in 2019. In cases in which the effects are defined by area, the analysis tries to estimate the portions of the area (and thus population) affected under the assumption of a uniformly distributed population within an LSOA. For air pollution, severance and greenspace (other health outcomes), more detailed postcode-level population impacts are assessed, tied to data ultimately rooted in the 2011 census.

5.1 Physical inactivity

Our analysis of physical inactivity concerns proximity to walking and cycling routes, and parks (for exercise)

In this section, we present our analysis of the impacts of transport infrastructure on the health risk of physical inactivity. This analysis models the upstream segments of the theorised causal chain, linking transport to physical activity (which is itself a determinant of health outcomes, not a health outcome). We had insufficient data to model the downstream impacts because the increases in physical activity associated with walking and cycling routes and urban parks are relatively modest. This increase in physical activity is too modest to link to most health outcomes, which depend on receiving a sufficiently high dose of physical activity to change.

Proximity to walking and cycling paths

A 2014 study of residents in three municipalities of the UK found that living within 1 km of a newly-built mixed walking and cycling route was associated with greater levels of physical activity two years after the route was built (Goodman *et al.*, 2014). Table 5.1 lists the increased average level of

combined walking and cycling activity per resident associated with living near such a development, by distance from the route.

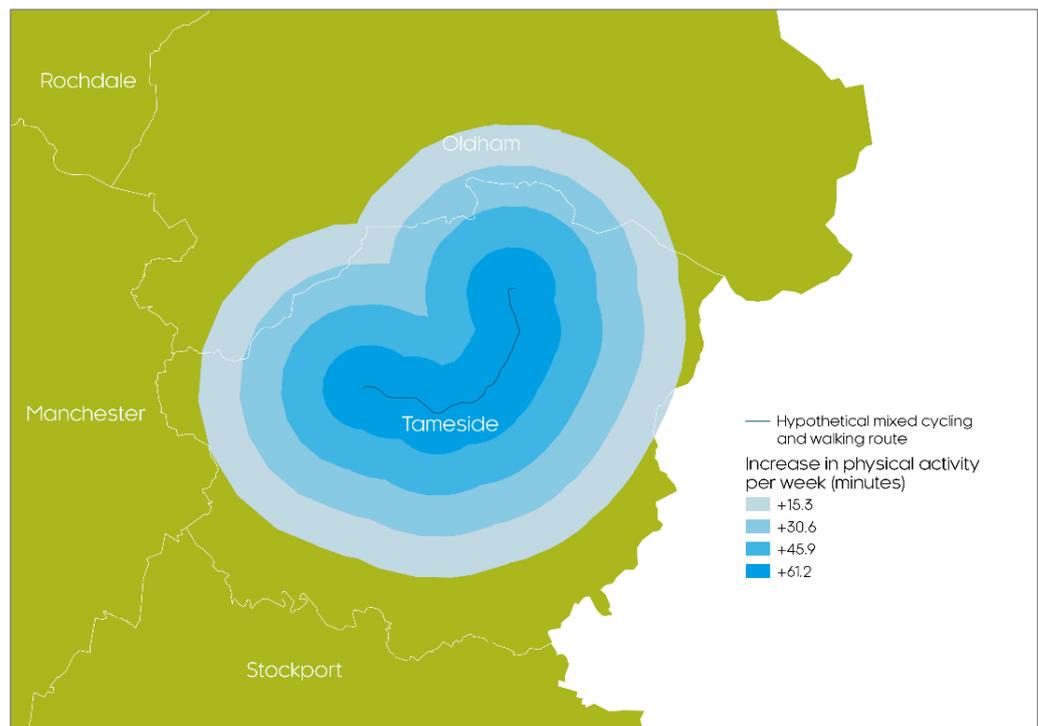
Table 5.1: Increased average walking and cycling activity by proximity to route

Distance of residence from route (km)	Increased average walking and cycling activity per week (minutes)
0-1	61.2
1-2	45.9
2-3	30.6
3-4	15.3

Note(s): Only routes within 4 km are considered
 Source(s): Goodman *et al.* (2014).

As an illustration of the approach before applying it to actual data for the North, Figure 5.1 depicts these physical activity benefits on a map with a hypothetical newly-built mixed walking and cycling route in the Tameside borough of Greater Manchester.

Figure 5.1: Increase in physical activity associated with hypothetical mixed walking and cycling route relative to reference (>4 km away from mixed cycling and walking route)

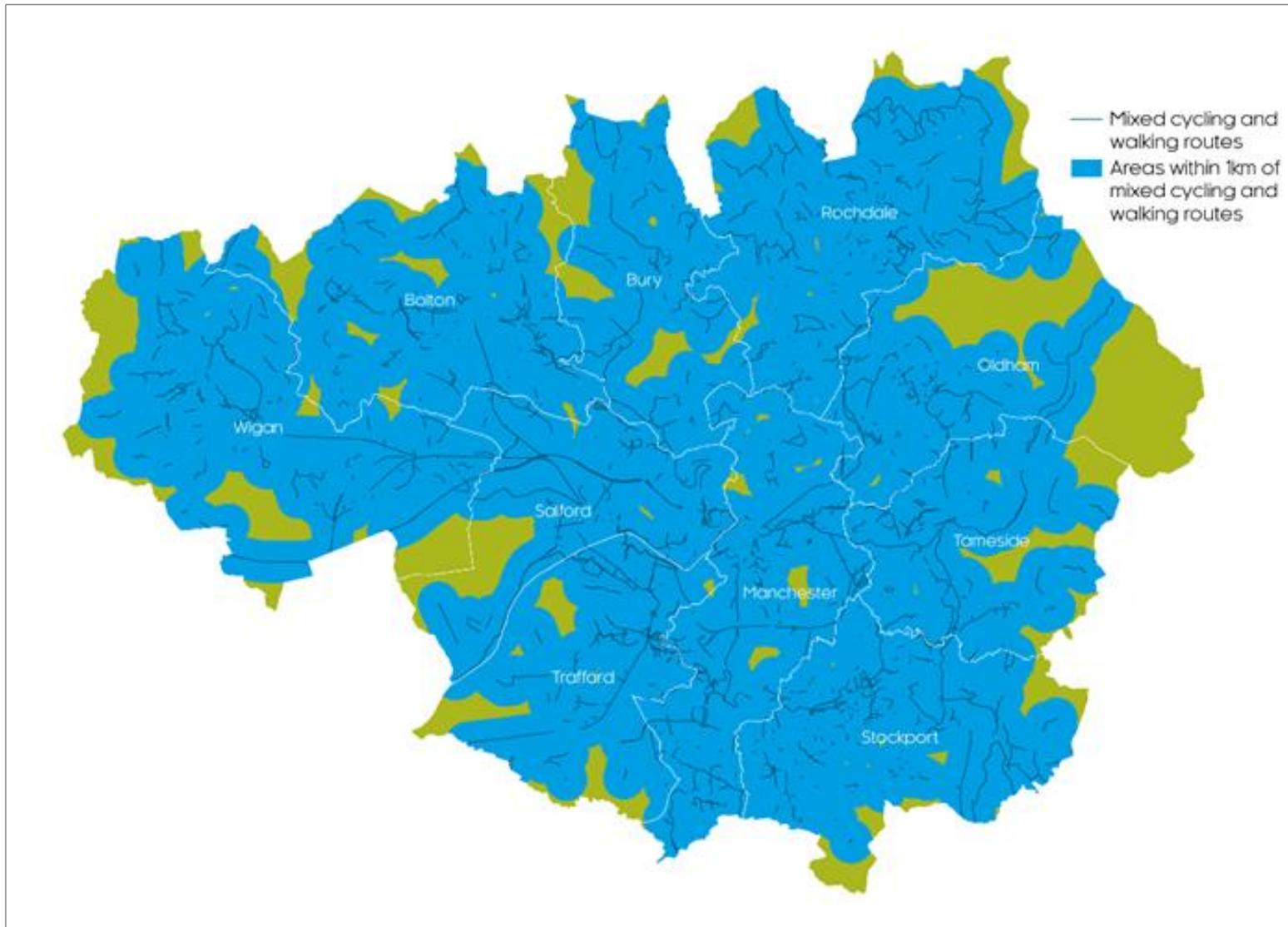


Source(s): Goodman *et al.* (2014); Cambridge Econometrics analysis.

The majority of land area in Greater Manchester is within 1 km of existing cycling infrastructure

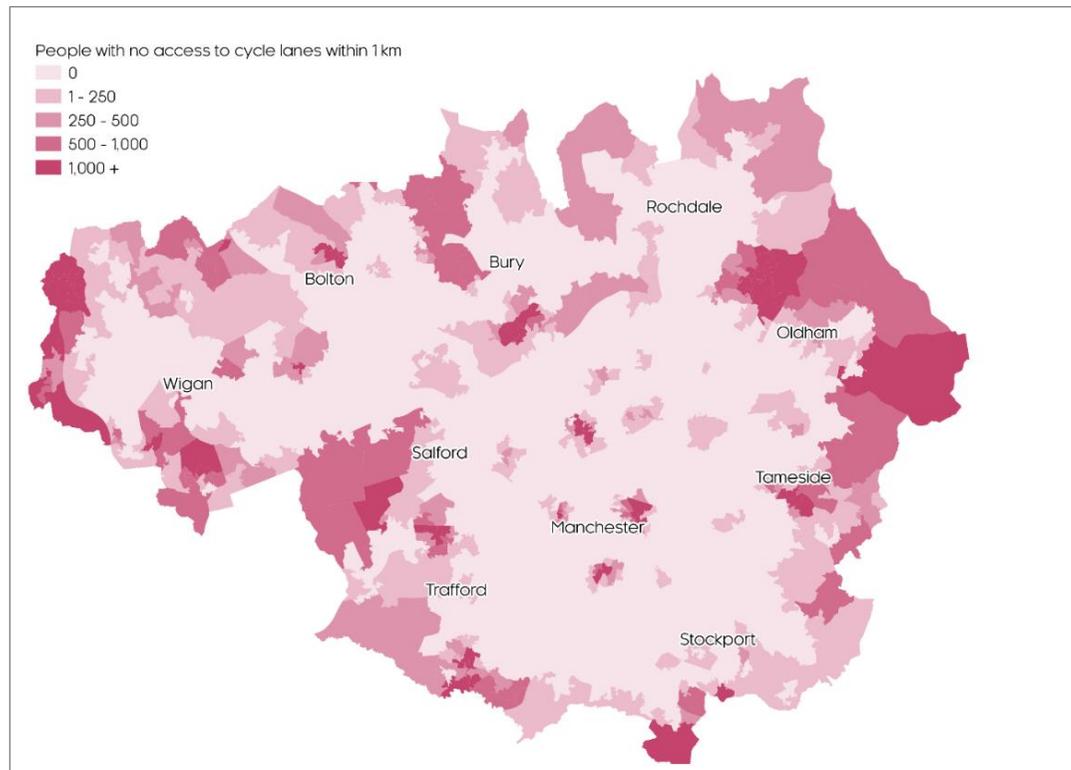
However, a relatively large urban centre like Greater Manchester has an existing network of walking and cycling routes that extends throughout the region. Thus, the marginal benefits of building new cycling infrastructure are harder to know, given the spread of existing infrastructure. Figure 5.2 displays the walking and cycling route network for Greater Manchester and the geographic area that lies within 1 km of any given section of this network. This map shows that a large majority of land area within Greater Manchester is within 1 km of existing cycling infrastructure.

Figure 5.2: Areas within 1 km of mixed cycling and walking routes in Greater Manchester



Source(s): Goodman *et al.* (2014); Cambridge Econometrics analysis.

Figure 5.3: Access to walking and cycling routes by LSOA in Greater Manchester



Source(s): Goodman *et al.* (2014); Office for National Statistics; Cambridge econometrics analysis.

Figure 5.3 shows the population of Greater Manchester by Lower Layer Super Output Area (LSOA) that does not live within 1 km of an existing mixed walking and cycling route. Over Greater Manchester, over 2.6m people have access to a cycle lane within 1 km of their home. Nevertheless, the map below also identifies 163,000 people with no nearby access (on distance alone). These areas are concentrated on the edges of the region, particularly around Bolton and Wigan. There are also a series of pockets with little or no access to cycling routes in the centre of the area. For example, over 5,000 people are more than 1 km from a cycling route in the Manchester 058B, Manchester 058D and Salford 016D LSOAs.

Our analysis of cycling and walking routes and their relationship to physical activity presumes that all infrastructure is of the same quality. However, the quality of existing routes in a city like Manchester varies depending on the type, age, location, etc. of the route. These details were not available in the geospatial data used in this analysis and are not well addressed by the literature linking built environment infrastructure to physical activity. Further information on quality and infrastructure usage could provide additional nuance to this analysis.

Proximity to parks

A 2016 study of individuals across 14 different global cities found that the density of parks near residences in urban areas is linearly associated with an increase in moderate to vigorous physical activity (MVPA) (Sallis *et al.*, 2016). Table 5.2 lists the increased physical activity associated with the number of parks within 0.5 km of a place of residence. Sallis *et al.* (2016) found this relationship to hold regardless of the size or quality of park(s).

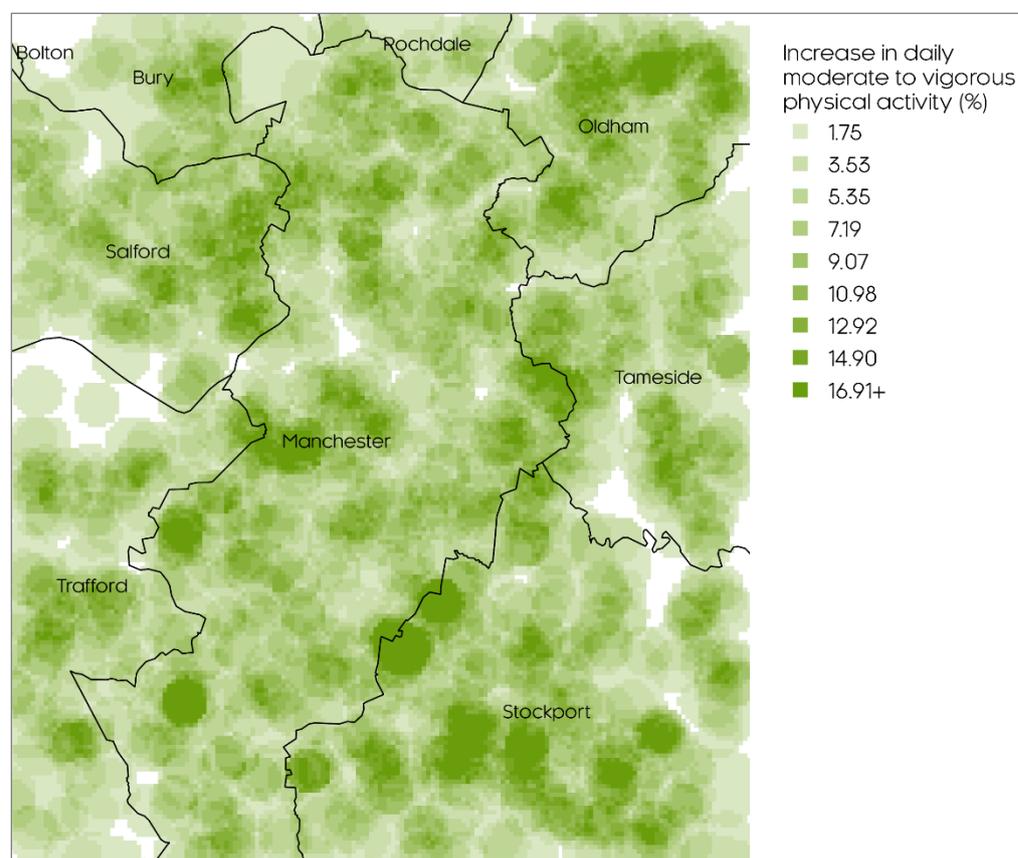
Table 5.2: Increased MVPA relative to the reference category (0 parks within 0.5 km)

Number of parks within 0.5 km buffer	Increase in daily MVPA (%)
1	1.75
2	3.53
3	5.35
4	7.19
5	9.07
6	10.98
7	12.92
8	14.90
9+	16.91+

Source(s): Sallis *et al.* (2016); Cambridge Econometrics analysis.

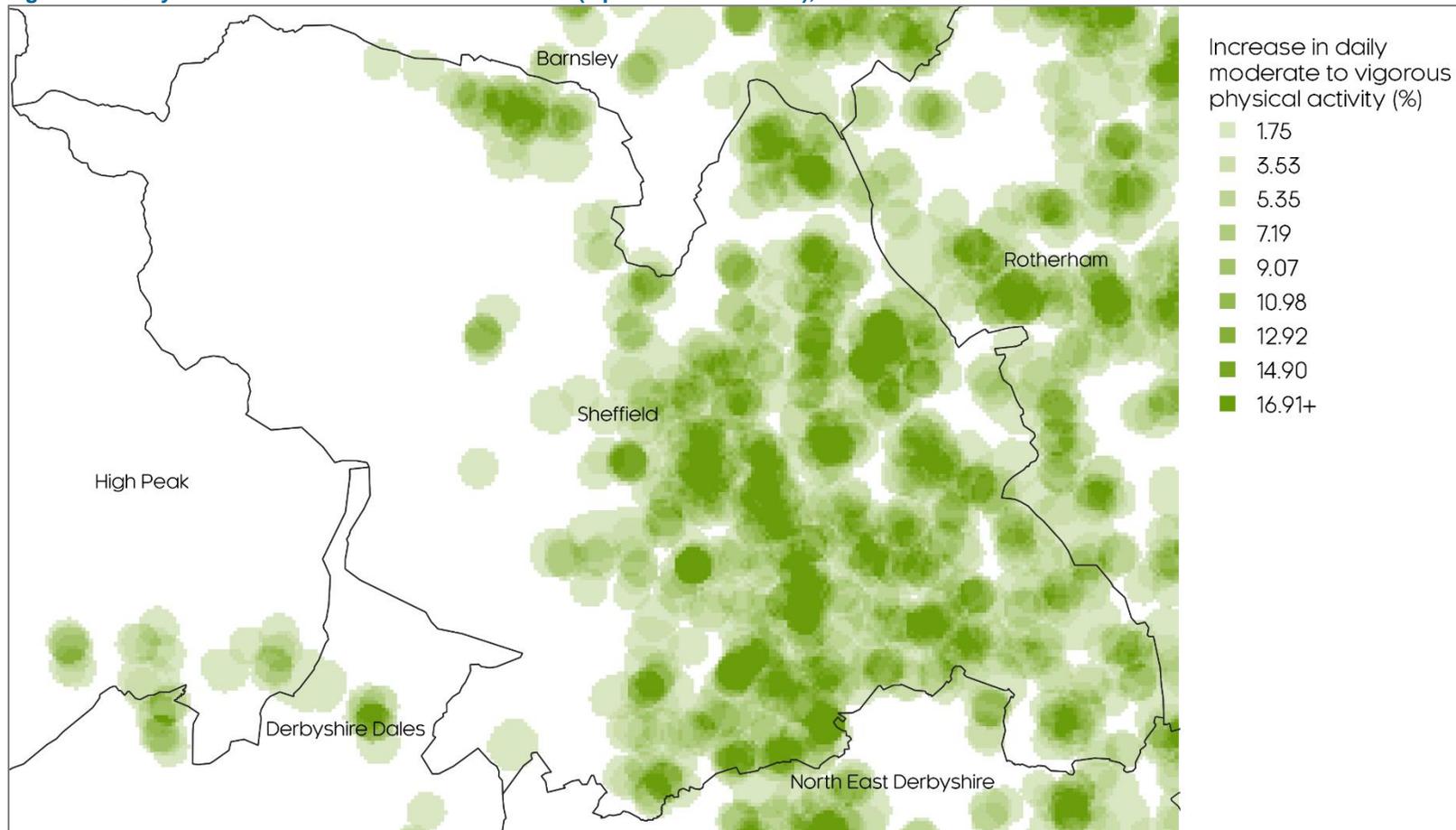
Using the values above, Figure 5.4 (Manchester) and Figure 5.5 (Sheffield) show, for two urban areas, how proximity to parks could increase daily MVPA. This is relative to areas with no parks within 0.5 km of the place of residence.

Figure 5.4: Daily increase in MVPA relative to reference (0 parks within 0.5 km), Manchester



Source(s): Sallis *et al.* (2016); Cambridge Econometrics analysis.

Figure 5.5: Daily increase in MVPA relative to reference (0 parks within 0.5 km), Sheffield



Source(s): Sallis *et al.* (2016); Cambridge Econometrics analysis.

In both maps, white spaces represent areas that are more than 0.5 km from any park and thus not expected to benefit (on the basis of the evidence used). Relative to Sheffield, Manchester has a higher density of urban parks, though there are certain parts of Sheffield area with access to many nearby parks. Note that Sallis *et al.* (2016) focused on parks in urban areas but that the white area to the west of Sheffield includes the Peak District, which would also be expected to confer health benefits. These are not assessed in this current piece of analysis.

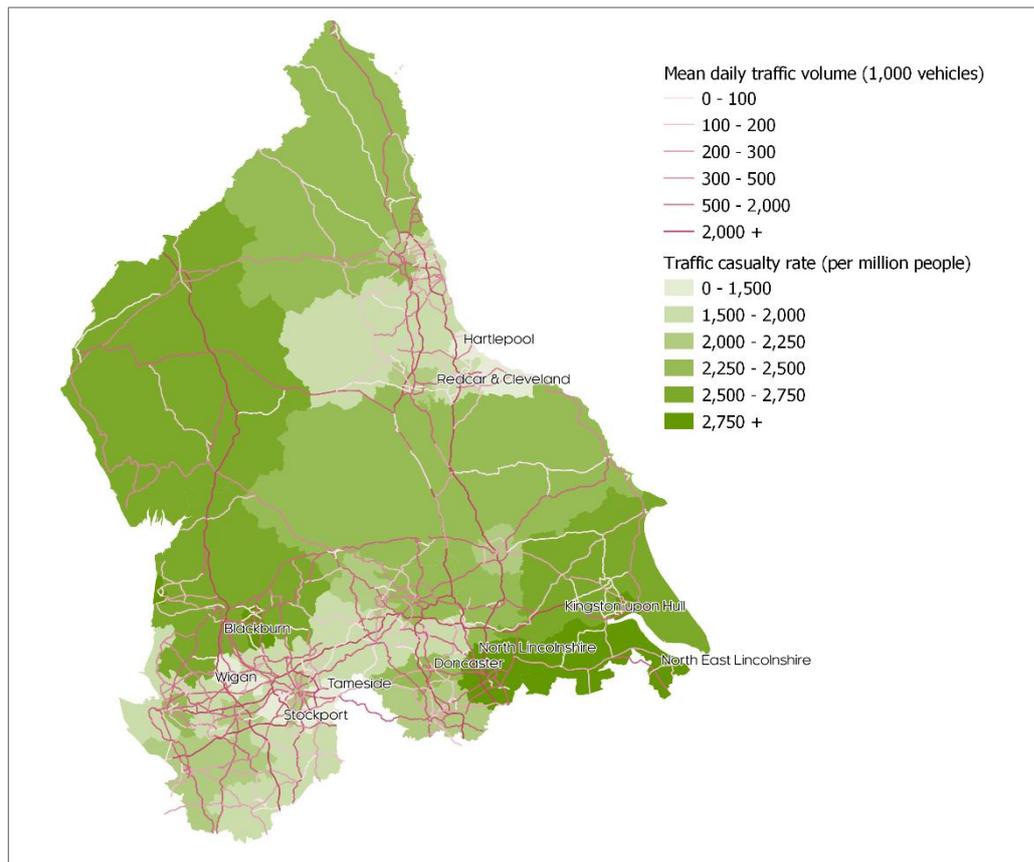
5.2 Incidents and safety

There were 1,752 road deaths recorded in the UK in 2019. At 26.4 deaths per million people, the UK's road death rate that year was 4 times lower than that of the US (36,096 deaths in a population of 332m people), and 2.5 times lower than New Zealand's (318 deaths; 5m people). This rate was slightly higher than that of Switzerland and the Nordic countries. Despite the UK's low rate by international standards, there is room for improvement, and there can be differences between regions.

There is great variation in the incidence rate across countries and, as the evidence below suggests, the occurrence of road traffic incidents is likely highly context specific.

In 2019, the North of England recorded 459 of the above deaths. This is proportionally more than the North's share of the UK population, implying a slightly higher death rate, of 30.8 per million people. Traffic incident and casualty data are available at the local authority level from the Department for Transport. Figure 5.6 presents the casualty rate per million inhabitants and shows areas of high/low traffic incident rates.

Figure 5.6: Casualty rates in the North of England



Note(s): The same rate is applied to all LADs where the data are only available at county level (Cumbria, Lancashire and North Yorkshire).

Source(s): Department for Transport 'Road traffic statistics' and 'Accidents by local authority'; Cambridge Econometrics analysis.

Table 5.3 presents road incident statistics for the four areas with the highest and lowest casualty rates. The highest casualty rate is found in Kingston upon Hull, followed by North East, and then North, Lincolnshire.

Table 5.3: Road incident statistics for selected areas

Geography	Casualty rate (per million people)	Casualties	KSI	Fatalities
Kingston upon Hull (highest)	3,603	936	149	7
North East Lincolnshire	3,259	520	77	3
North Lincolnshire	3,152	543	90	13
Blackburn	3,013	451	116	4
Hartlepool	1,377	129	30	1
Stockport	1,346	395	59	8
Redcar & Cleveland	1,342	184	51	5
Wigan (lowest)	1,244	409	112	15

Note(s): KSI - Killed or Seriously Injured.

Source(s): Department for Transport 'Accidents by local authority'.

Serious incidents (not shown), follow the population distribution, with Leeds, Sheffield and Liverpool on top.⁹ The high traffic volume in those three areas is in line with the evidence of a link between traffic volume and incident occurrence. Figure 5.6 also suggests some relationship between traffic volume and the casualty rate, with areas like Cumbria and Lancashire having heavy traffic and high casualty rates. On the other hand there are notable exceptions with Wigan, Stockport, Kirklees and Calderdale all showing high traffic volume but low casualty rates. More granular incident data would be needed for further analysis.

Roshandel et al. (2015) discuss the factors that matter in the probability of an incident taking place. Table 5.4 below shows the statistically significant factors affecting the odds ratio of a traffic incident taking place.

Table 5.4: Factors affecting traffic incident occurrences

	Change in odds ratio of a traffic incident per unit increase (%)
Average speed	-4.8
Traffic volume	0.1
Speed variation	22.5
Speed difference	3.2

Source(s): Roshandel *et al.* (2015).

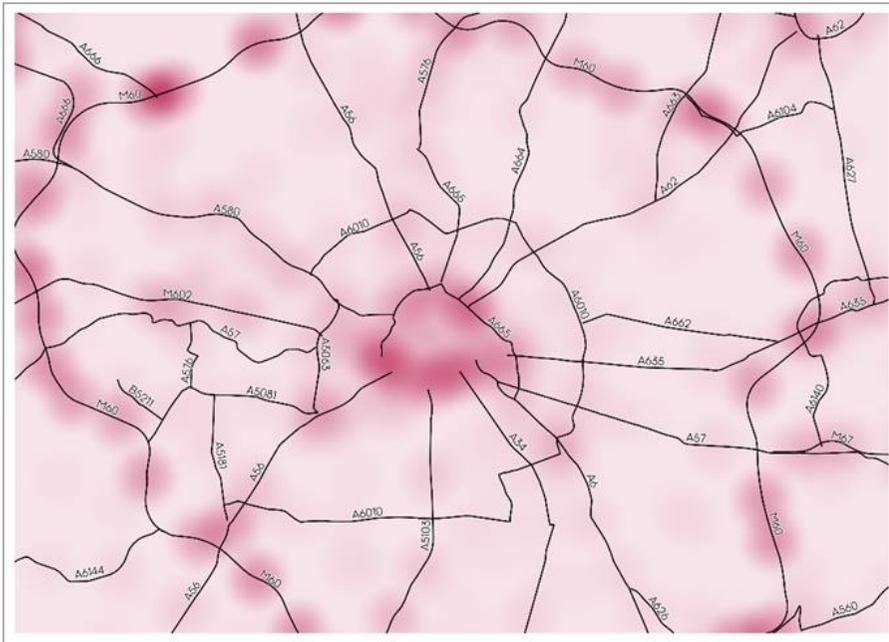
Average speed is the only factor with a negative impact on the probability of an incident. As Roshandel *et al.* (2015) point out, 'this result is not surprising because stop and go driving conditions are associated with lower average speeds, and the outcome being assessed is crash occurrence and not severity'.

- then highlight locations and coincidence or otherwise with traffic volumes

⁹ These figures exclude the three counties analysed – North Yorkshire, Lancashire and Cumbria.

To examine the hypothetical coincidence of traffic incidents with volumes, data for the exact location of traffic incidents is available for Greater Manchester (see Figure 5.7 and Figure 5.8).

Figure 5.7: Traffic volume in Greater Manchester



Note(s): Individual traffic counts are weighted by their volume before creating the heatmap.

Source(s): Department for Transport 'Road traffic statistics'; Department for Transport; Cambridge Econometrics analysis.

Figure 5.8: Traffic incidents in Greater Manchester



Note(s): Individual incidents are weighted by the severity index that accompanies the dataset. Contains Transport for Greater Manchester data. Contains OS data © Crown copyright and database right 2021.

Source(s): Transport for Greater Manchester 'GM Road Casualty Accidents'; Department for Transport; Cambridge Econometrics analysis.

Figure 5.8 shows how casualties are concentrated around junctions and roads with lower speed limits in city centres. This highlights how low- and medium-speed roads have higher casualty rates and are thus incident hotspots. This is also reflected in the casualty rate per road, which is ten times lower for motorways when compared to A roads (as shown in the DfT data). This may explain the relatively low number of incidents around the M60 in Manchester, despite high traffic volume.

As data are available at relatively limited geographical detail, any relationship between traffic volume and the casualty rate in the North is not clearly visible. This may also be partly because varying incident rates by road type can cloud this relationship. The analysis shows the lowest incident rates on Motorways, at 58 per billion miles. This is followed by 'A Roads' (347) and 'Other Roads' (440). Smaller roads can therefore lead to more accidents, even when they have less traffic. This is supported by the literature, which suggests that speed (which is related to the road type) is negatively correlated with the probability of a traffic incident. Other variables that have significant explanatory power in the literature include speed variation, which would be interesting to gather data on.

5.3 Air pollution

Air pollution increases the risk of hospitalisation and mortality

Our analysis of air pollution concerns the health effects of six pollutants (see Table 5.5) for which (modelled) data are available from Defra as annual means. By Requia, Adams, *et al* (2018), these pollutants can be translated from measured concentrations into the following (increases in) health risk:

- hospital admissions
- mortality

Table 5.5: Air pollutants and their main sources

Pollutant	Main source(s)
Carbon monoxide (CO)	Cars, industrial furnaces
Nitrogen dioxide (NO ₂)	Fossil fuels, cars
Sulphur dioxide (SO ₂)	Fossil fuels, mineral ore smelting
Particles <10 µm in diameter (PM ₁₀)	Dust, pollen, mould, tire and brake wear
Particles <2.5 µm in diameter (PM _{2.5})	Combustion, organic compounds, metals
Ozone (O ₃)	Indirectly from NOx

The analysis that follows presents figures for 2019, as the last year of pre-pandemic data i.e. before movement restrictions.

Table 5.6 summarises the range of (increased) health risks across the North for five of the six pollutants, calculated from the Defra emissions data for 2019.¹⁰

¹⁰ Because the Defra data report ozone different, as number of days on which a threshold was passed (120 µg/m³), we treat this separately in the analysis that follows.

Table 5.6: Increased health risks from air pollution (per 100,000)

	Hospital admissions		Mortality	
	Mean	Maximum	Mean	Maximum
Carbon monoxide (CO)	4	5	-	-
Nitrogen dioxide (NO ₂)	1,325	6,445	1,115	5,427
Sulphur dioxide (SO ₂)	202	1,935	61	589
Particles <10 µm in diameter (PM ₁₀)	1,713	3,447	1,178	2,370
Particles <2.5 µm in diameter (PM _{2.5})	1,051	1,937	1,511	2,784

Note(s): Risk estimates calculated from Requia, Adams *et al.* (2018), who did not find a link between carbon monoxide and mortality.

Source(s): Defra 'Modelled background pollution data', Requia, Adams *et al.* (2018); Cambridge Econometrics analysis.

All prevalence observed in 2019 is below the UK government guidance for mean annual concentrations. These limits are 40 µg/m³ for NO₂ and PM₁₀, and 25 µg/m³ for PM_{2.5}, while the maximum prevalence observed is 34, 22 and 12 µg/m³ respectively.¹¹ Table 5.7 below shows the distribution of the impacts of the three most harmful pollutants across the population of the north.

Table 5.7: Population affected by impacts tied to air pollution

Health impact: increased risk of mortality	Population affected ('000s)	Proportion of affected population in lowest IMD decile (%)
Nitrogen dioxide		
High impact (over 2.33%)	5,880	30
Medium impact	5,540	14
Low impact (up to 1.58%)	4,411	6
Particulate Matter 2.5		
High impact (over 2.0%)	5,850	28
Medium impact	5,150	14
Low impact (up to 1.68%)	4,540	10
Particulate Matter 10		
High impact (over 1.50%)	5,640	26
Medium impact	5,320	16
Low impact (up to 1.27%)	4,570	10

Note(s): Totals may not be equal across impacts due to rounding error. Risk brackets for 'low', 'medium' and 'high' divide the population into equal thirds. Across the north, 18% of the population find themselves in the lowest IMD decile. Population impacts are calculated at a postcode level and then grouped by IMD LSOA when reporting deprivation.

Source(s): UK Data Service 'UK 2011 census Postcode Headcounts'; Cambridge Econometrics analysis.

A clear pattern emerges from the table above, with the areas of 'high' increase risk of mortality from air pollution having a larger proportion of population in the lowest IMD decile (26 – 30%). For reference, an average of 18% of the population of the north find themselves in the lowest IMD decile so this 26-30% means worse-off people are disproportionately represented in these high impact areas. On the other hand, in areas of 'low' risk only 6 - 10% of the

¹¹ Defra, 'UK Air Quality Limits' [Air Quality Objectives Update.pdf \(defra.gov.uk\)](https://www.defra.gov.uk/air-quality-obj/objupdate.pdf), Cambridge Econometrics Analysis

population are within the lowest IMD decile. This suggests a strong association between pollution and deprivation. We also note the tendency for people living in these deprived areas to be younger. It was beyond the scope of this work to consider causal factors.

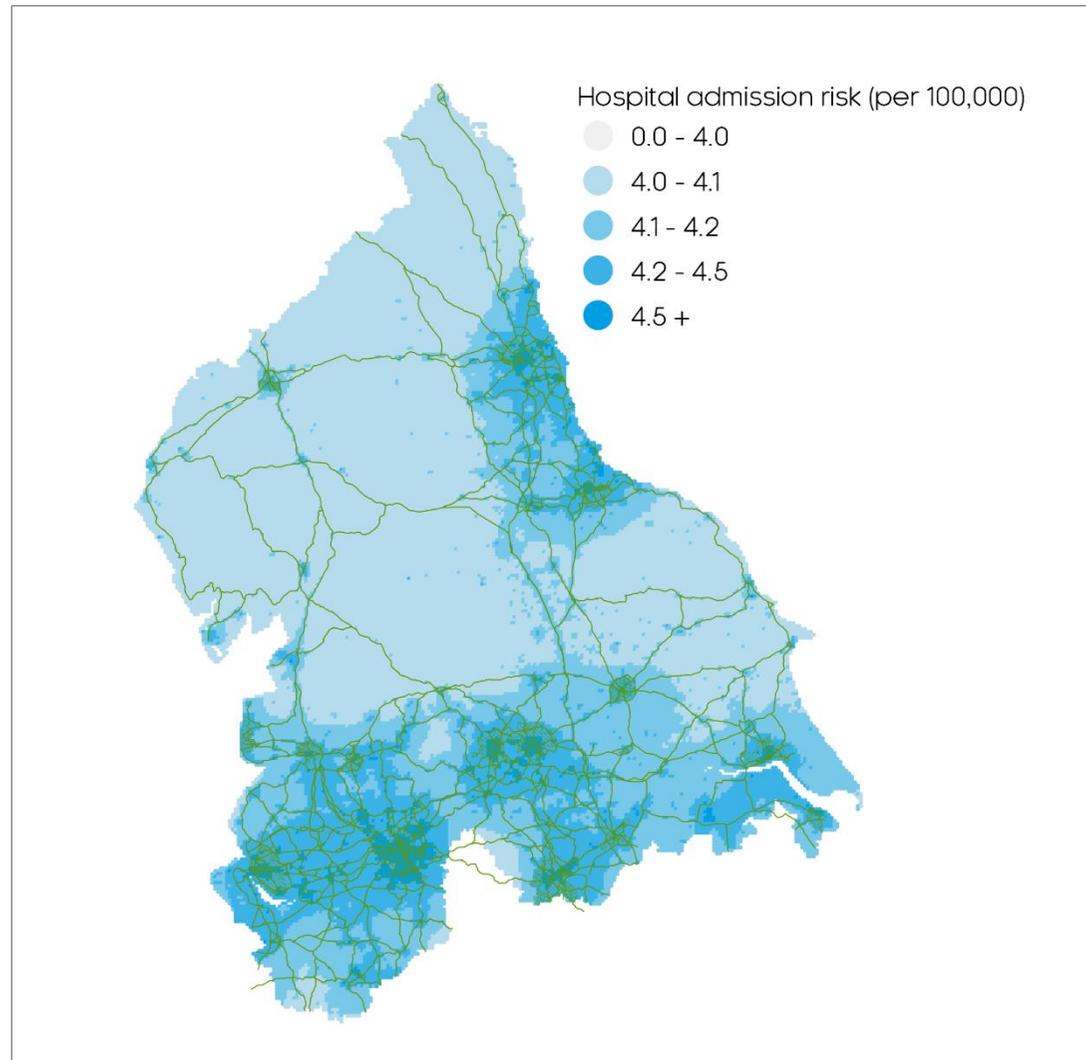
Carbon monoxide

Carbon monoxide arises mainly from internal combustion of fossil fuels (most commonly road transport) and industrial processes. Higher concentrations are thus found around residential areas and major roads; and industrial zones. Consequently, heightened risks of hospital admissions are in these same places, and especially the more densely populated residential areas (see Figure 5.9).

When compared to the other pollutants considered, the risk of such admissions is relatively low for carbon monoxide. Even in areas with high concentrations, the annual estimated admissions risk rises by, at most, 5 people per 100,000 in the most built-up urban areas. This rate is three orders of magnitude smaller than, for example, nitrogen dioxide (as below).

Requia, Adams, *et al* (2018) did not find any clear relationship between carbon monoxide exposure and mortality.

Figure 5.9: Increased hospital annual admission risk from carbon monoxide



Note(s): Risk estimates calculated from Requia, Adams *et al* (2018).

Source(s): Defra 'Modelled background pollution data', Requia, Adams *et al* (2018); Cambridge Econometrics analysis.

Nitrogen dioxide

Nitrogen dioxide exposure substantially increases hospitalisation and mortality risk

Nitrogen dioxide (NO₂) is mainly formed from cars and combustion of fossil fuels. We therefore see a similar spatial distribution as for carbon monoxide (see Figure 5.11).

However, the associated health risks are significantly higher for NO₂ than carbon monoxide, increasing the risk of hospital admission by as much as 6,445 people per 100,000. This compares to a rate of 36 people per 100,000 for carbon monoxide (as above).

The associated risk of mortality is also high from NO₂ exposure, increasing the risk by as much as 5,427 people per 100,000 in the highest-emissions areas.

Given the source of these emissions, the health risks are concentrated in densely populated areas and therefore have significant public health implications.

PM₁₀ and PM_{2.5}

Health impacts arise more from PM_{2.5} (in residential areas) than PM₁₀ (along major roads)

Particulate matter refers to any non-gas substance in the air and so can come from a variety of sources. From transport, coarser PM₁₀ is associated with trace metals emitted during vehicle motion as well as tire and brake wear (Defra, 2005). Finer particulate matter (PM_{2.5}) is associated with exhaust emissions from diesel vehicles, and also tire and brake wear (Defra, 2012). However, there is no data available on the emissions by source and pollutant, therefore the analysis cannot isolate pollution linked exclusively to transport.

Increased risk of mortality associated with PM_{2.5} is concentrated in densely populated areas. In contrast, heightened mortality risk associated with PM₁₀ is more clearly concentrated around major roads (see Figure 5.12). The health impacts of particulates are thus more consequential for PM_{2.5} given the location of the population of the north.

Although both sizes of particle arise from road traffic, the evidence suggests that, while PM_{2.5} concentrations are high within 1 metre of the kerb, these particulates are quick to disperse, with limited concentrations past that distance (Defra, 2012). PM₁₀ is slower to disperse, leading to a wider spread around the road network. This is visible in Figure 5.12.

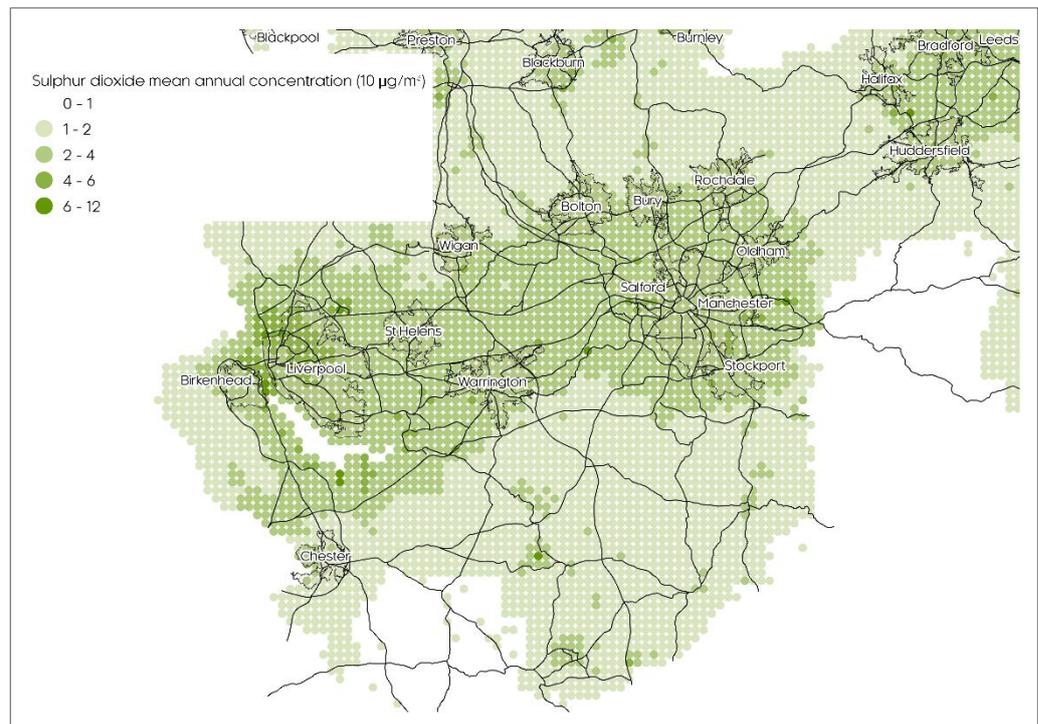
Sulphur dioxide

Health impacts from sulphur dioxide also cluster around population centres

The main source of sulphur dioxide emissions is fossil fuel combustion. Again, this leads to the pollutant concentrating around population centres and industrial areas. Sulphur dioxide is more of an industrial than a transport pollutant. As such, concentrations of sulphur dioxide follow the road network less clearly compared with carbon monoxide and nitrogen dioxide. The estimated increase in mortality risk ranges from 61 to 589 per 100,000 people, and is concentrated around densely populated areas.

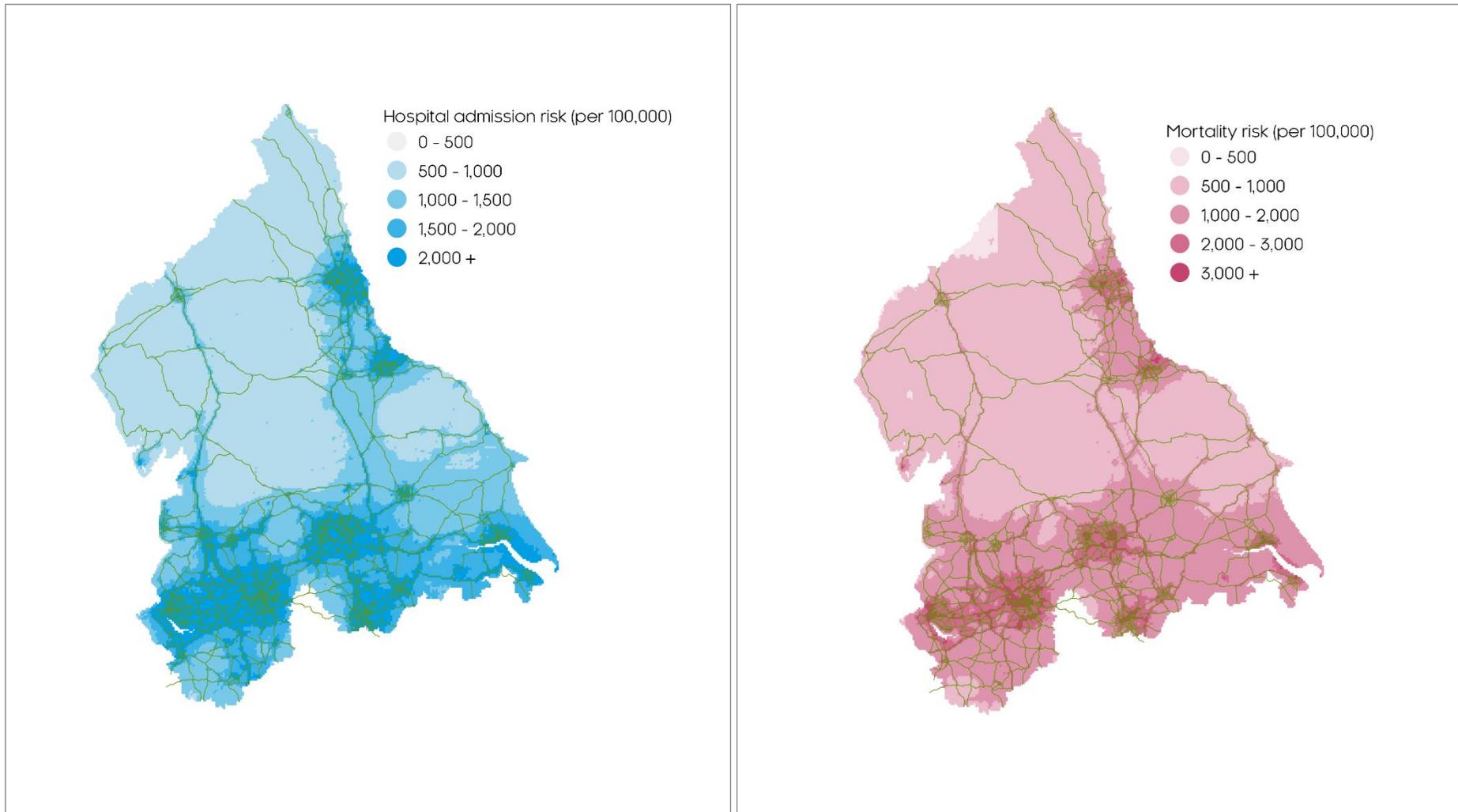
The associated increases in hospital admission risk are wider, ranging from 202 to 1,935 people per 100,000, by virtue of the larger coefficients. The highest concentrations are not clustered around major road networks and thus are more likely to be industry- rather than transport-related.

Figure 5.10: Concentrations of SO₂ around Manchester and Liverpool



Source(s): Defra 'Modelled background pollution data'.

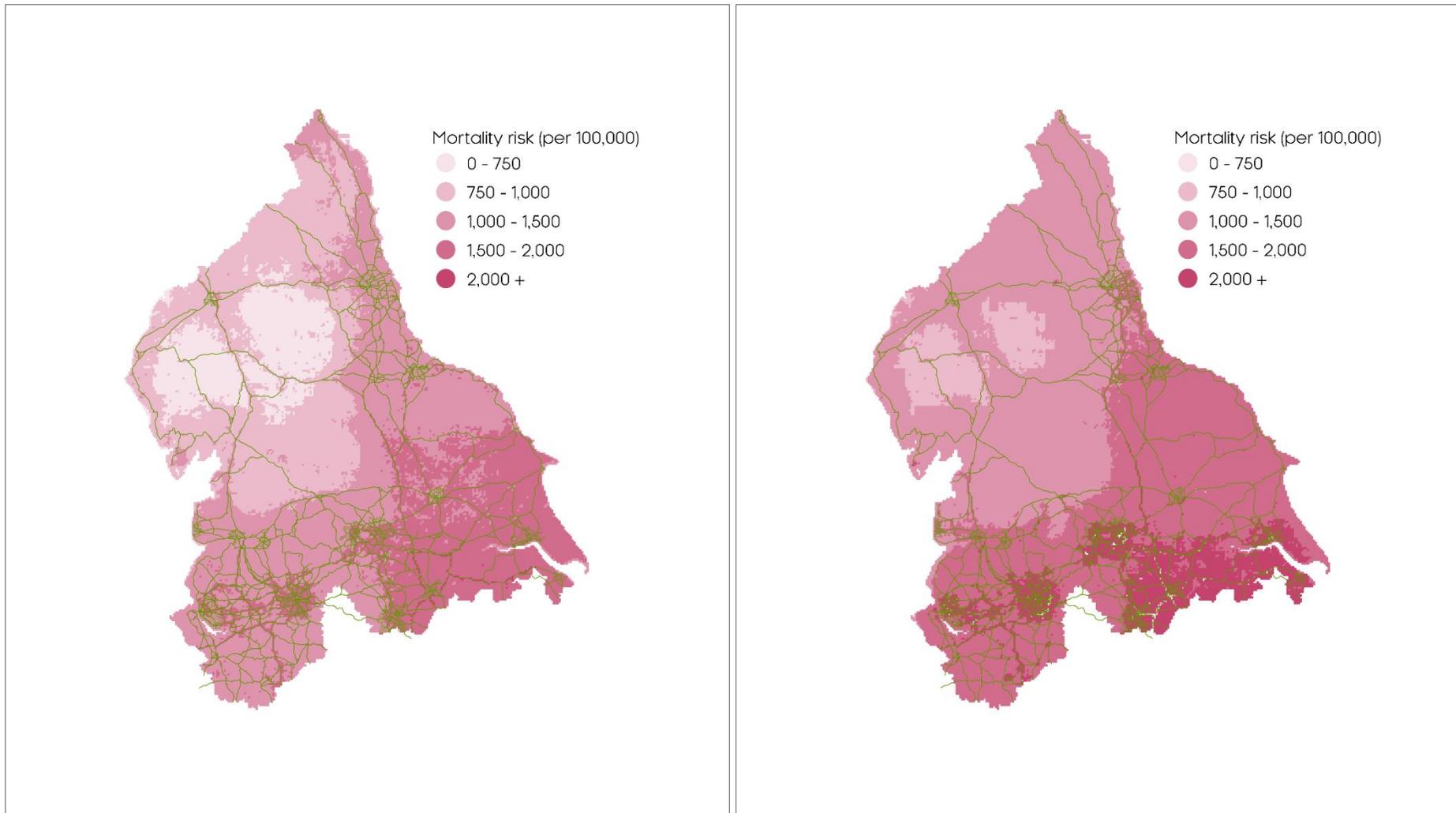
Figure 5.11: Increased health risks from nitrogen dioxide



Note(s): Risk estimates calculated from Requia, Adams *et al* (2018).

Source(s): Defra 'Modelled background pollution data', Requia, Adams *et al* (2018); Cambridge Econometrics analysis.

Figure 5.12: Increased mortality risk from PM₁₀ (left) and PM_{2.5} (right)



Note(s): Risk estimates calculated from Requia, Adams *et al* (2018).

Source(s): Defra 'Modelled background pollution data', Requia, Adams *et al* (2018); Cambridge Econometrics analysis.

Ozone

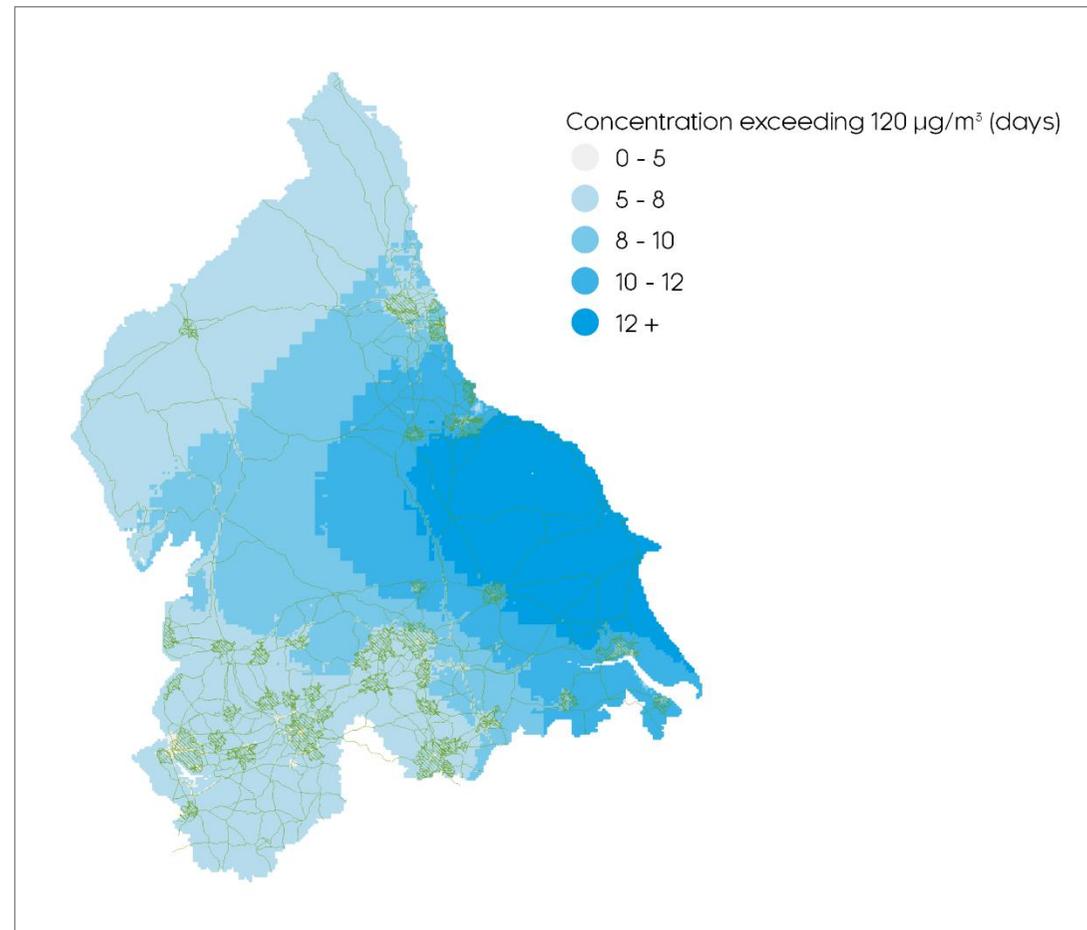
Ozone is a powerful oxidant that causes damage to mucous and respiratory tissues in animals, as well as plant tissues. Low level (tropospheric) ozone is the product of two anthropogenic pollutants, forming when nitrogen oxides react with volatile organic compounds (VOCs). Sources of VOCs include chemical plants and oil-based paints. Ozone can take hours or days to form and may reach maximum concentrations many miles downwind of these original sources.¹²

European guidance sets an air quality standard for ozone by which concentrations should not exceed $120 \mu\text{g}/\text{m}^3$ (the maximum daily eight-hour mean) on more than 25 days each year (averaged over three years).¹³

Compared to other pollutants considered in this analysis, the health risks from ozone exposure are relatively low. Even if an area were to exceed these concentrations every day of the year, hospitalisation and mortality risks would increase by just 19 and 8 people per 100,000, respectively.

Figure 5.13 shows the number of days on which ozone concentrations exceeded the above threshold in 2019. The map shows the highest exposure is quite far from population centres in the north, suggesting quite limited impacts (especially given the comparatively smaller increases in health risks).

Figure 5.13: Areas of high annual ozone exposure



Note(s): Risk estimates calculated from Requia, Adams *et al* (2018).

Source(s): Defra 'Modelled background pollution data', Requia, Adams *et al* (2018); Cambridge Econometrics analysis.

¹² UK Air Pollution Information System: Ozone:
http://www.apis.ac.uk/overview/pollutants/overview_o3.htm

¹³ European Commission 'Air quality standards':
<https://ec.europa.eu/environment/air/quality/standards.htm>

5.4 Limited access to green space, recreation and leisure

The association between proximity to green space and human health has been long established by the literature. With increasing urbanisation, the lack of green space in cities has been noted as a risk factor for a range of physiological and psychological conditions. Green space is thought to affect health in many indirect ways, such as by increasing opportunities for physical activity, social interaction, cleaner air, sun exposure, and exposure to micro-organisms within the natural environment. All of these can be linked to better health outcomes.

The North of England is filled with broadly-defined green space, especially in more remote or rural areas of the region. Our analysis examines the relationship between residential proximity to green space (including areas with tree cover, open green/grassy areas [excluding farmland], and areas with other low-lying vegetation) and the following health outcomes:¹⁴

- wellbeing, focusing on Manchester and Newcastle, owing to the urban focus of the underlying evidence
- diabetes
- psychosocial distress
- self-rated general health

The wellbeing analysis suggests that around half of the population of Manchester does not live within 300 metres of green space of sufficient size to confer wellbeing benefits. The benefits for those in proximity to green space are relatively mild, though, increasing wellbeing scores by no more than 0.5%.

The reduced risk of type 2 diabetes due to proximity to green space is most concentrated in areas that are less populated, with urban areas, especially those in the corridor from Sheffield and Leeds to Newcastle and the southeast area around Lincolnshire, most at risk from type 2 diabetes as a result of limited access to green space.

The reduced risk of psychosocial distress is most widespread across the region, as this health outcome is dependent upon a lower threshold of proximate green space as well as a broader definition of green space compared to self-report general health (as below; by including tree canopy coverage).

The risk reduction in self-reported fair or poor general health (a negative health outcome) is the most diffuse, as this health outcome is dependent on tree canopy coverage, which makes up a smaller proportion of the green space in the North of England.

Overall, the region could be defined as one in which the health risks due to lack of green space are most acute in urban areas, though there are many rural/remote areas with green space near those major cities.

¹⁴ For the purposes of our analysis, green space is defined as deciduous woodland, coniferous woodland, improved grassland, neutral grassland, calcareous grassland, acid grassland, heather, and heather grassland, as per the UK Centre for Ecology and Hydrology (UKCEH) land use categorisation.

Tree canopy is defined as deciduous or coniferous woodland, per the UKCEH land use categorisation.

Wellbeing

Our analysis of the wellbeing benefits of green space uses the indicators defined in the Annual Population Survey (APS). Looking at green space in terms of its wellbeing impacts is only applicable in urban settings, as most rural places will have access to abundant natural green space or fields within 300 metres. The results of a study by Houlden *et al.* (2018) for London are applied to the Manchester area, as the largest urban area in the North and thus closest to London in size. Given the city focus of the evidence we do not apply the approach to the entire North. The paper's results could be applied to other large urban areas but not in towns or rural areas because of the nature of the underlying evidence and the greater abundance of green space.

Table 5.8 shows that the benefits of being near green space (within 300 metres: around a five-minute walk) depend on the size (area) of that green space. The analysis maps proximity to such green space and the associated wellbeing benefits by area.

Table 5.8: Wellbeing benefits of green space

	Increase in the wellbeing indicator per km ² of green space within 300 metres (%)	p-value
Life satisfaction	0.8034	< 0.001
Worthwhile	0.7398	< 0.001
Happiness	0.5208	< 0.001

Note(s): Life satisfaction - Very high rating of satisfaction with their lives overall.
 Worthwhile - Very high rating of how worthwhile the things they do are.
 Happiness - Rated their happiness yesterday as very high.
 The percentages above refer to the change in the score, measured on a five-point scale.

Source(s): Houlden *et al.* (2018).

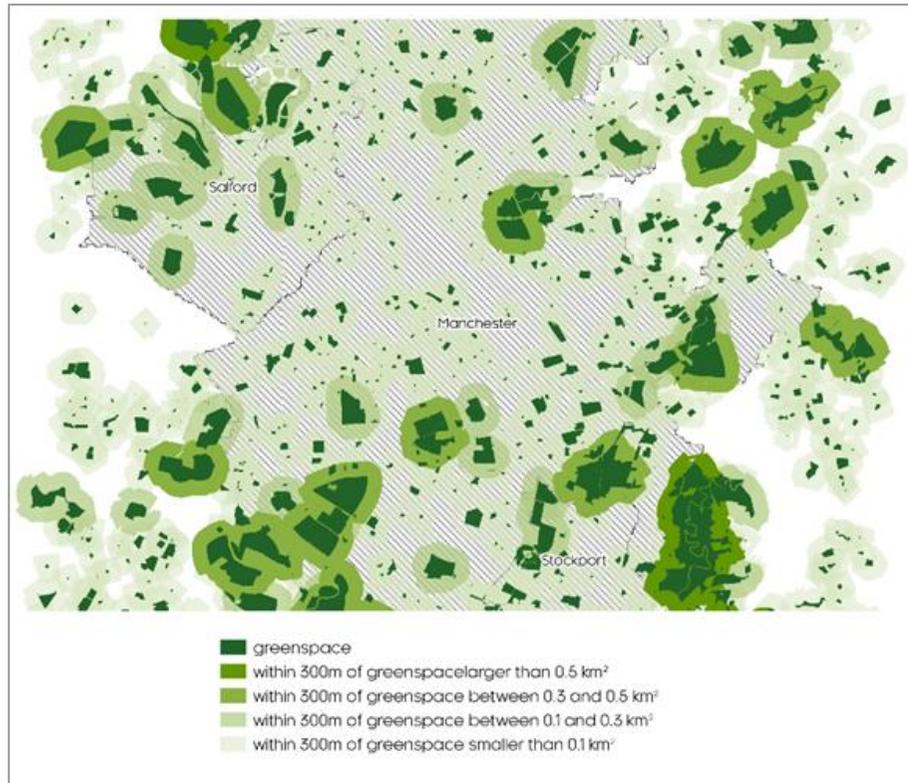
Figure 5.14 shows green space for the Manchester area. Each green space area is surrounded by a 300-metre buffer to proxy access. The buffers are coloured according to the size of the green space, to show the size of the associated wellbeing benefits.

Visibly grey areas are not within 300 metres of any (identified) green space and, by our approach, do not benefit from increased wellbeing. People living within 300 metres of parks larger than 0.5 km² are estimated to have improved life satisfaction by at least 0.4%, with their sense of how worthwhile their activities are, and happiness also increasing by at least 0.37% and 0.26%, respectively. Those near parks with an area of 0.3 km² would benefit from increased life satisfaction, sense of worth and happiness by 0.24%, 0.22% and 0.16%, respectively.

Young people in Manchester benefit the least from existing green space

Of note is that the least green LSOAs also have the lowest median age (see Figure 5.15). This suggests that, in terms of wellbeing, younger people benefit the least from existing green space.

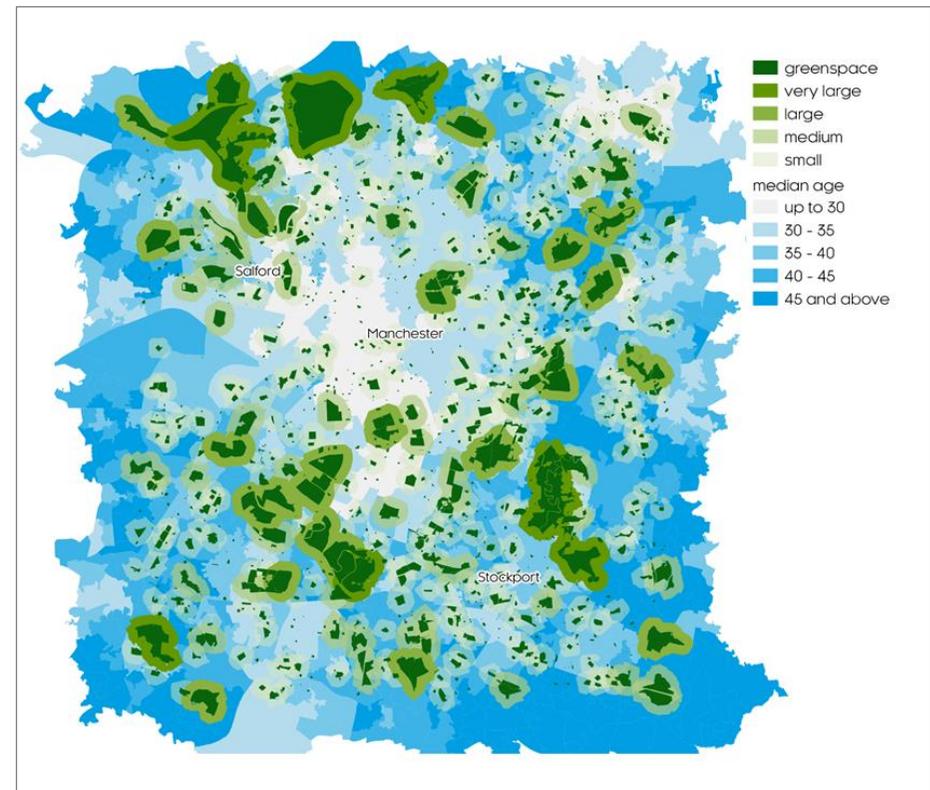
Figure 5.14: Green space around Manchester



Note(s): Some parks appear as multiple areas (rather than a single area), reflecting their representation in the underlying data.

Source(s): Ordnance Survey 'Open Greenspace'; Cambridge Econometrics analysis.

Figure 5.15: Green space and median age around Manchester



Note(s): Some parks appear as multiple areas (rather than a single area), reflecting their representation in the underlying data.

Green spaces are classified as very large (larger than 0.5 km²), large (between 0.3 and 0.5 km²), medium (between 0.1 and 0.3 km²) and small (between 0.01 and 0.1 km²). Very small green space (smaller than 0.01 km² or 1 hectare) is excluded because of its minimal estimated wellbeing impacts.

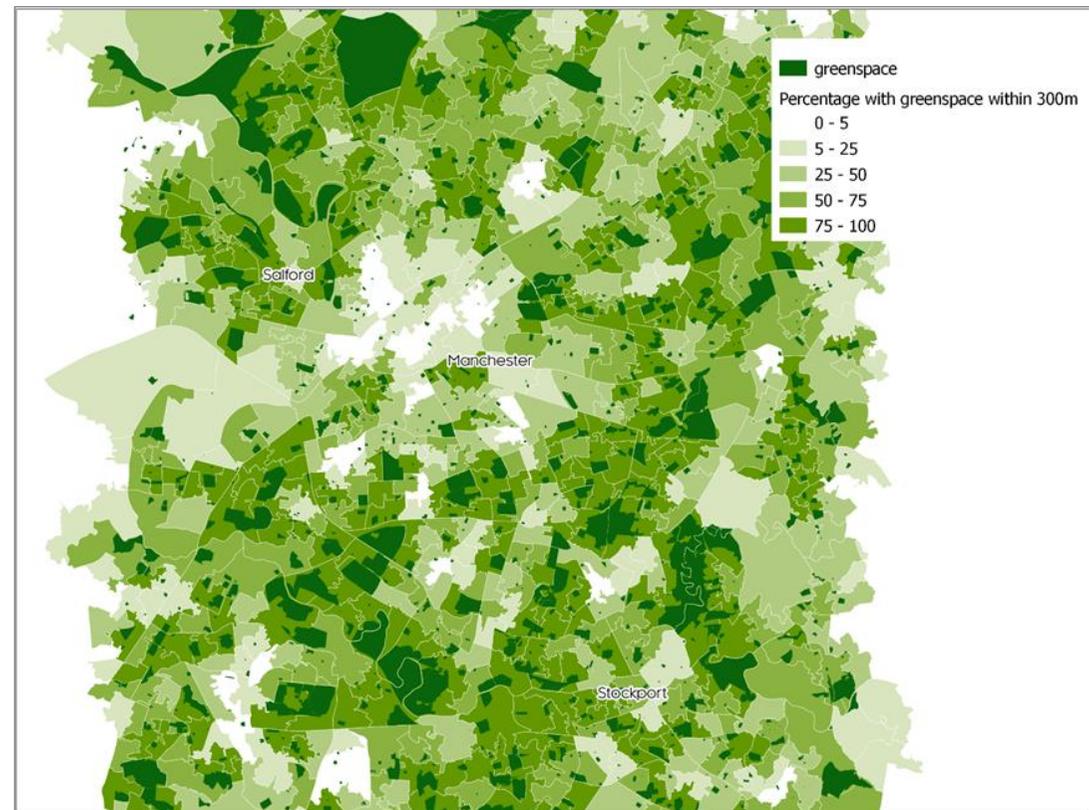
Source(s): Ordnance Survey 'Open Greenspace', ONS 'Lower layer Super Output Area population estimates'; Cambridge Econometrics analysis.

The magnitude of the wellbeing impacts quickly diminishes with decreasing park size. Densely populated areas in the centre of Manchester do not have easy access to large green space. This means that the potential wellbeing benefits of creating a new green space there would be significant and reach a large part of the population.

Assuming constant population density within each LSOA, we estimate that 800,000 people in the Manchester area have no green space larger than a hectare within 300 metres of their home. That is equivalent to 51% of the area's population.

Figure 5.16 identifies the percentage of people in each LSOA who have access to green space within 300 metres of their homes. In white and light-green areas, less than 25% of the population has access to green space larger than a hectare within 300 metres of their home.

Figure 5.16: Share of population in Manchester with green space within 300m of their homes



Note(s): Very small green space (smaller than 0.01 km² or 1 hectare) is excluded because of its minimal estimated wellbeing impacts.

Source(s): Ordnance Survey 'Open Greenspace', ONS 'Lower layer Super Output Area population estimates'; Cambridge Econometrics analysis.

Applying the same method to Newcastle shows quite different results. In the area examined, 324,645 people (69% of the population) are estimated to have access to green space within 300 metres of their home, whereas 146,631 (the remaining 31%) have not. In 20 LSOAs, **less than a quarter of the population** has nearby access to green space. In contrast, in 211 LSOAs, **more than half the population** is estimated to have access to greenspace. Two LSOAs (totalling 5,835 people) have no nearby access to greenspace: 006F (Salters Road, north of Nuns Moor) and 023H (near Newcastle train station).

Figure 5.17: Share of population in Newcastle with green space within 300m of their homes



Note(s): Very small green space (smaller than 0.01 km² or 1 hectare) is excluded because of its minimal estimated wellbeing impacts.

Source(s): Ordnance Survey 'Open Greenspace', ONS 'Lower layer Super Output Area population estimates'; Cambridge Econometrics analysis.

Diabetes

A study (Astall-Burt *et al.*, 2014) of more than 250,000 people in Australia found that living in an area where more than 40% of the land in a 1 km radius is green space is associated with a significantly reduced risk of developing type 2 diabetes. Table 5.9 lists the reduced risk of developing type 2 diabetes associated with living in an area with specific increments of green space within a 1 km radius.

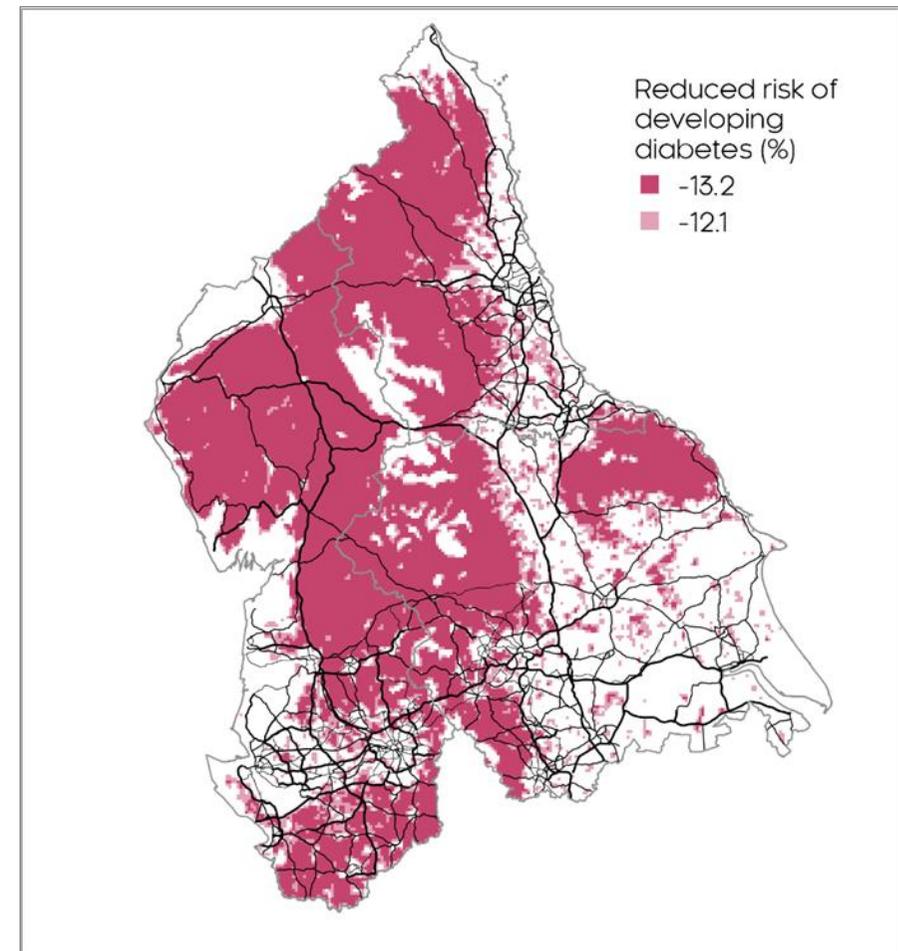
Figure 5.18 shows the spatial distribution of that reduced risk, highlighting the areas away from / around major cities. White areas on the map correspond to areas that have a lower density of green space within a 1 km radius (less than 40% of the surrounding area is covered by health-enhancing green space). The predominant land use in these areas is mostly urban, suburban, and farmland as well as rock- or sand-covered spaces in coastal areas.

Table 5.9: Reduced risk of type 2 diabetes relative to reference category (<40% within 1 km radius)

Green space increment (% within 1km radius)	Change in risk (%)
41-60	-12.1
60+	-13.2

Source(s): Astall-Burt *et al.* (2014).

Figure 5.18: Reduced risk of type 2 diabetes from proximity to green space



Source(s): Astall-Burt *et al.* (2014); Department for Transport (2020); UK Centre for Ecology & Hydrology; Cambridge Econometrics analysis.

Psychosocial distress

A study (Astell-Burt and Feng, 2019) of more than 45,000 people in Australia found that living in an area where more than 5% of the land in a 1-mile (1.6 km) radius is green space is associated with a significantly reduced risk of psychosocial distress. Table 5.10 reports the reduced risk of psychosocial distress associated with living in an area with specific increments of green space within a 1-mile radius.

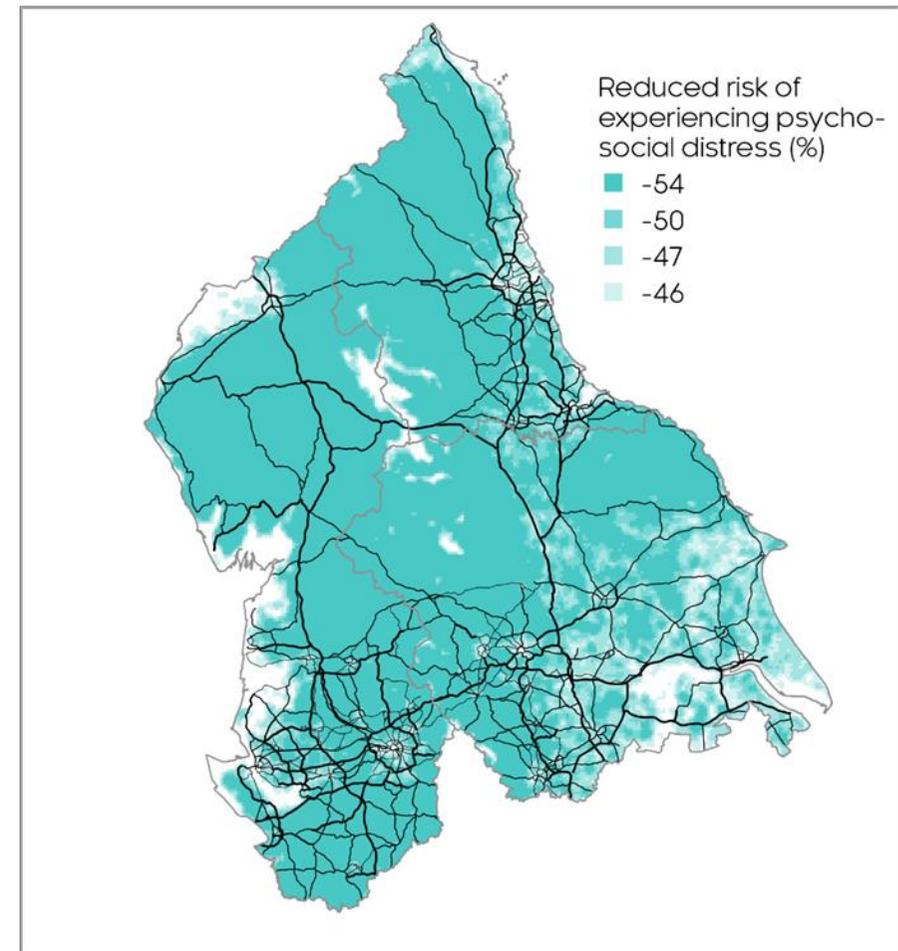
Figure 5.18 shows the spatial distribution of that risk reduction to be much more wide-ranging than for type 2 diabetes risk (as above) owing to the lower threshold identified for health benefits. The white space on this map corresponds to areas that have less than 5% of land within a 1-mile radius as green space. This lower threshold (especially compared with the diabetes analysis) translates to a large impact area across the region of the North.

Table 5.10: Reduced risk of psychosocial distress relative to reference category (<5% within 1-mile radius)

Green space increment (% within 1-mile radius)	Change in risk (%)
5-9	-46
10-19	-47
20-29	-50
30+	-54

Source(s): Astell-Burt and Feng (2019).

Figure 5.19: Reduced risk of psychosocial distress from proximity to green space



Source(s): Astell-Burt and Feng (2019); Department for Transport (2020); UK Centre for Ecology & Hydrology; Cambridge Econometrics analysis.

Self-rated general health

A study (Astell-Burt and Feng, 2019; as for psychosocial distress) of more than 45,000 people in Australia found that living in an area where more than 10% of the land in a 1-mile (1.6km) radius is tree canopy is associated with a significantly reduced risk of self-rated fair or poor general health. Table 5.11 lists the reduced risk of self-rated fair or poor general health associated with living in an area with specific increments of tree canopy within a 1-mile radius.

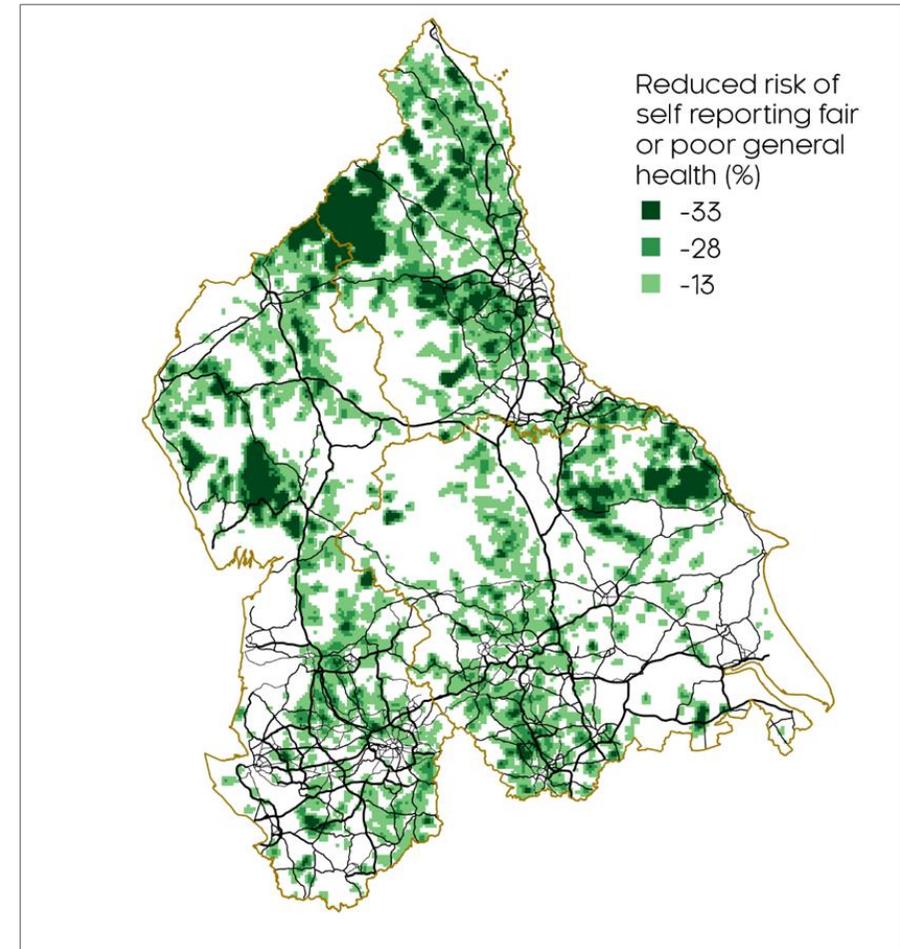
Figure 5.20 shows the spatial distribution of that risk reduction, with at least some areas in and around cities in the North. White spaces on this map correspond to areas with less than 10% of land within a 1-mile radius covered by tree canopy. According to Astell-Burth and Feng, people living there would be more likely to report poor general health, all other things constant. Relative to more broadly-defined green space, areas with sufficiently dense tree canopy are rarer in the North. The areas enjoying the greatest benefits of proximity to tree canopy are more concentrated in the northern half of the region, around Northumberland and Lake District National Parks. The North York Moors near Scarborough also offer good tree coverage.

Table 5.11: Reduced risk of self-rated fair or poor general health relative to reference category (<10% within 1-mile radius)

Tree canopy increment (% within 1-mile radius)	Reduced risk (%)
10-19	-13
20-29	-28
30+	-33

Source(s): Astell-Burt and Feng (2019).

Figure 5.20: Spatial risk of self-rated fair or poor general health from proximity to tree canopy in the North of England



Source(s): Astell-Burt and Feng (2019); Department for Transport (2020); UK Centre for Ecology & Hydrology; Cambridge Econometrics analysis.

Areas with the greatest health benefits from proximity to green space are less likely to be deprived areas

The 2011 census (the basis for our postcode-level analysis) reports 14.9m people living in the North of England, with the 2020 population estimates from Nomis reporting a more recent figure of 15.6m. From our (2011-based) analysis, some 5.2m people live in areas that benefit from lower risk of diabetes, 14.7m people live in areas that benefit from lower risk of psychosocial distress, and 9.1m people live in areas that benefit from a lower risk of self-rated fair to poor general health in the North. Table 5.12 lists the numbers of people in the North affected by each of these impacts. For diabetes and self-rated general health, those that live in the areas of highest risk were also more likely to be in the lowest decile of the 2015 English Indices of Multiple Deprivation (IMD). For psychosocial distress, few people (around 200,000) live in areas with the highest risk (receiving no estimated benefit from green space).

There is evidence of a steeper social gradient, with over one-third of people receiving the smallest benefit also living in the most deprived areas; while the rate falls to just over one in eight for areas seeing the highest benefit. In all cases, the areas enjoying the greatest health benefits from proximity to green space were least likely to have populations in the lowest IMD decile. This finding suggests that the health benefits of green space are unevenly distributed in the North, favouring wealthier or less deprived areas.

Table 5.12: Population affected by impacts tied to proximity to green space

Impact	Population affected ('000s)	Proportion of affected population in lowest IMD decile (%)
Diabetes		
Highest risk (0% risk reduction)	9,720	23.6
12.1% risk reduction	2,900	13.2
13.2% risk reduction	2,270	5.0
Psychosocial distress		
Highest risk (0% risk reduction)	200	16.7
46% risk reduction	490	34.9
47% risk reduction	1,920	30.9
50% risk reduction	2,970	23.8
54% risk reduction	9,310	13.8
Fair to poor general health		
Highest risk (0% risk reduction)	5,750	22.8
13% risk reduction	6,230	18.1
28% risk reduction	2,310	13.3
33% risk reduction	600	7.0

Note(s): Population totals (middle column) may not be equal across impacts due to rounding.

Source(s): Cambridge Econometrics analysis.

5.5 Noise pollution

Traffic noise has both physical and mental health impacts

Noise in the environment is a stressor that can trigger physiological and psychological responses in the body. Chronic noise exposure is a risk factor

for a range of non-communicable health conditions, including heart disease (Münzel *et al.*, 2018) and depression (Seidler *et al.*, 2017).

This analysis focuses on the relationships between:

- road traffic noise and physical health: coronary heart disease (drawing on a meta-analysis by Babisch, 2014) and hypertension (van Kempen and Babisch, 2012)
- road and rail traffic noise, and mental health: depression (Seidler *et al.*, 2017)

A meta-analysis by Babisch (2014) considered 24 studies on the relationship between road traffic noise and coronary heart disease and found an odds ratio of 1.08 for each increment of 10 decibels (dB) from 55 to 75 dB.

For hypertension, van Kempen and Babisch (2012) considered 27 studies in their meta-analysis of the relationship with road traffic noise and found an odds ratio of 1.034 for each increment of 5 dB from 45 to 75dB.

Table 5.13 lists the increases in the risks of coronary heart disease and hypertension associated with living in an area with road traffic noise.¹⁵ The table begins at 55 dB to match the measurements in the accompanying traffic noise data from Defra.

Table 5.13: Increased physical health risks from road traffic noise

Increase in noise (dB)	Increase in health risk (%)	
	Coronary heart disease	Hypertension
55.0 - 59.9	8.0	6.9
60.0 - 64.9	8.0	10.6
65.0 - 69.9	16.6	14.3
70.0 - 74.9	16.6	18.2
75.0+	26.0	22.2

Source(s): Coronary heart disease: Babisch (2014).
Hypertension: van Kempen and Babisch (2012).

Both road and rail traffic noise increase depression risk, but rail impacts are less certain at high noise levels

Seidler *et al.* (2017) considered the association, in Germany, between both road and rail traffic noise, and depression. This study found a strong, positive relationship between road traffic noise in one's place of residence and the risk of experiencing depression. The authors also found that rail traffic noise does increase the risk of experiencing depression, but this effect was not significant at higher levels of noise, likely because of fewer observations at close proximity to the rail network. Table 5.14 lists the increase in risk of depression associated with living in an area with road and rail traffic noise.

¹⁵ Measured as the average noise level in decibels over a 16-hour period between 07:00 and 23:00.

Table 5.14: Increased mental health risks from road and rail traffic noise

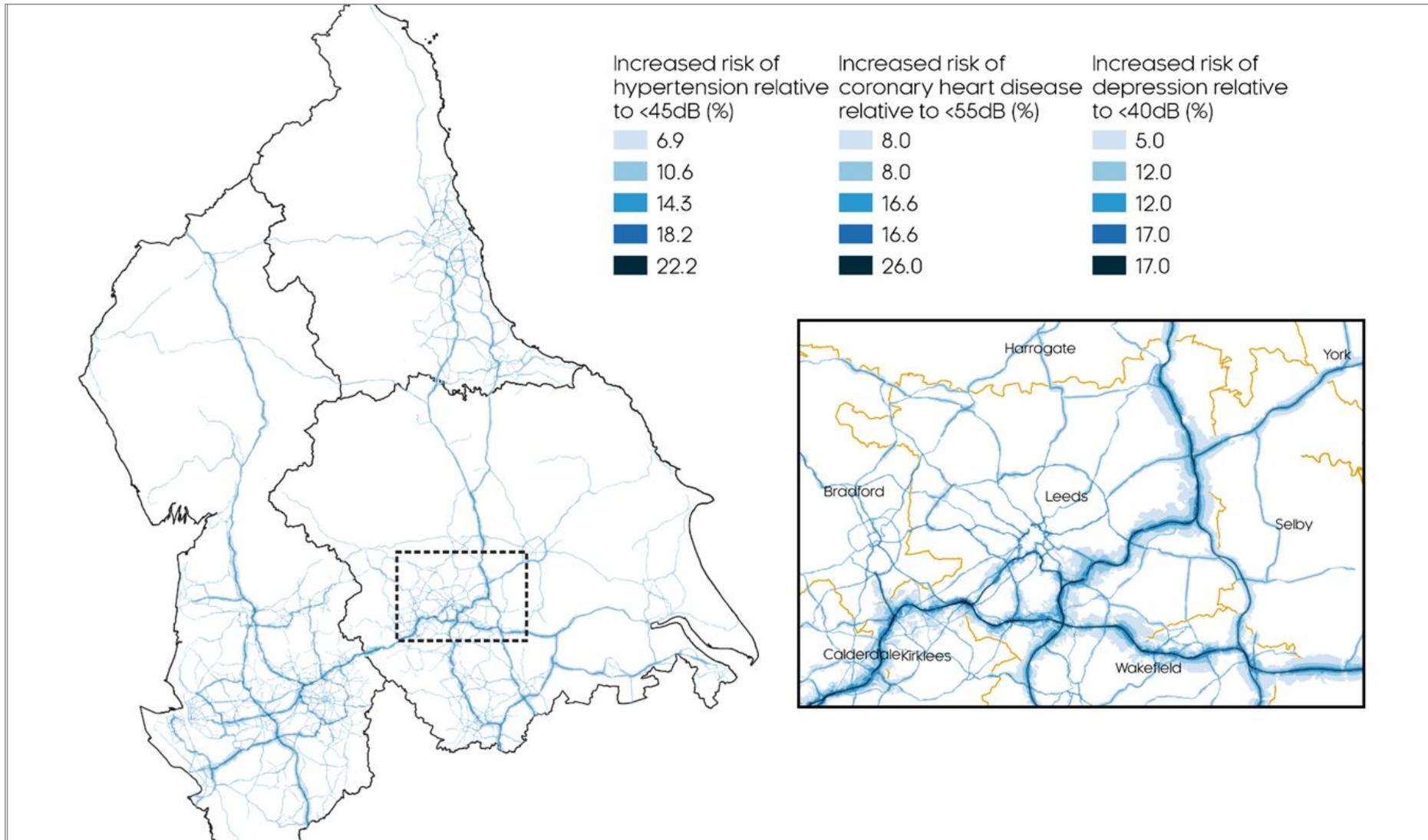
Increase in noise (dB)	Increase in depression risk (%)	
	Road	Rail
55.0 - 59.9	5.0	6.0
60.0 - 64.9	12.0	15.0
65.0 - 69.9	12.0	7.0*
70.0 - 74.9	17.0	-7.0*
75.0+	17.0	-7.0*

Note(s): * denotes estimates that are uncertain and not statistically significant at the 5% level. This is likely due to small sample sizes in close proximity to rail

Source(s): Seidler *et al.* (2017).

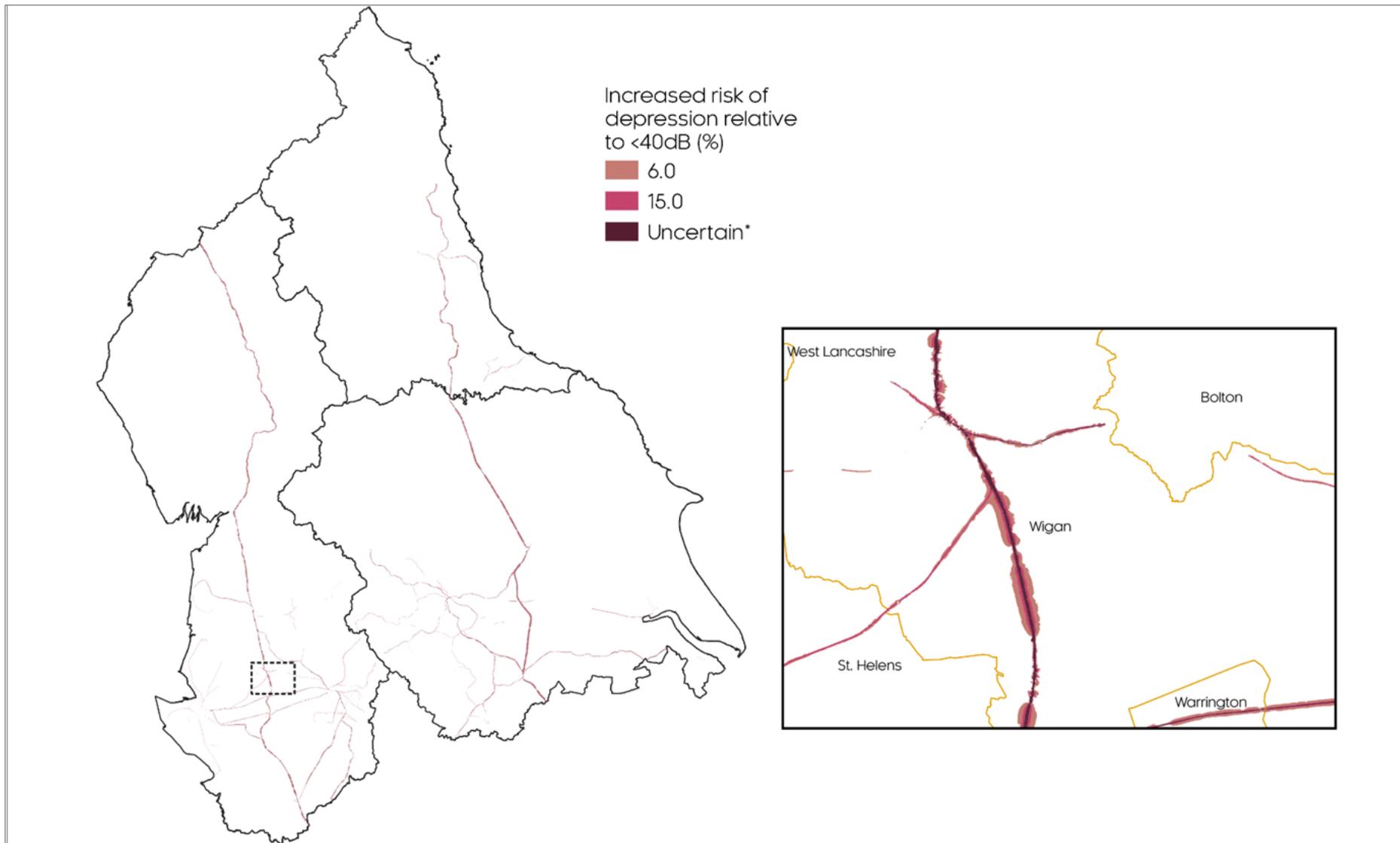
Figure 5.21 shows that the areas with the highest risk of health impacts due to road traffic noise are concentrated around major motorways, including more densely-populated urban areas around Manchester, Liverpool, Leeds, and Newcastle. The risk of depression due to rail traffic noise is much more diffuse, though there are areas of higher risk concentrated around two major north-south rail lines: one leading to Glasgow in the west and the other heading to Edinburgh in the east (see Figure 5.22). Both are electric, therefore noise differences may be due to the frequency rather than type of service. Generally, areas of high rail traffic noise do not extend as far from rail tracks as road traffic noise does from major roads and even more so for motorways, suggesting rail transport contributes much less to the burden of disease than does road transport.

Figure 5.21: Increased health risks from road traffic noise



Source(s): Babisch (2014), van Kempen and Babisch (2012), Seidler et al. (2017); Defra; Cambridge Econometrics analysis.

Figure 5.22: Increased mental health risks from rail traffic noise



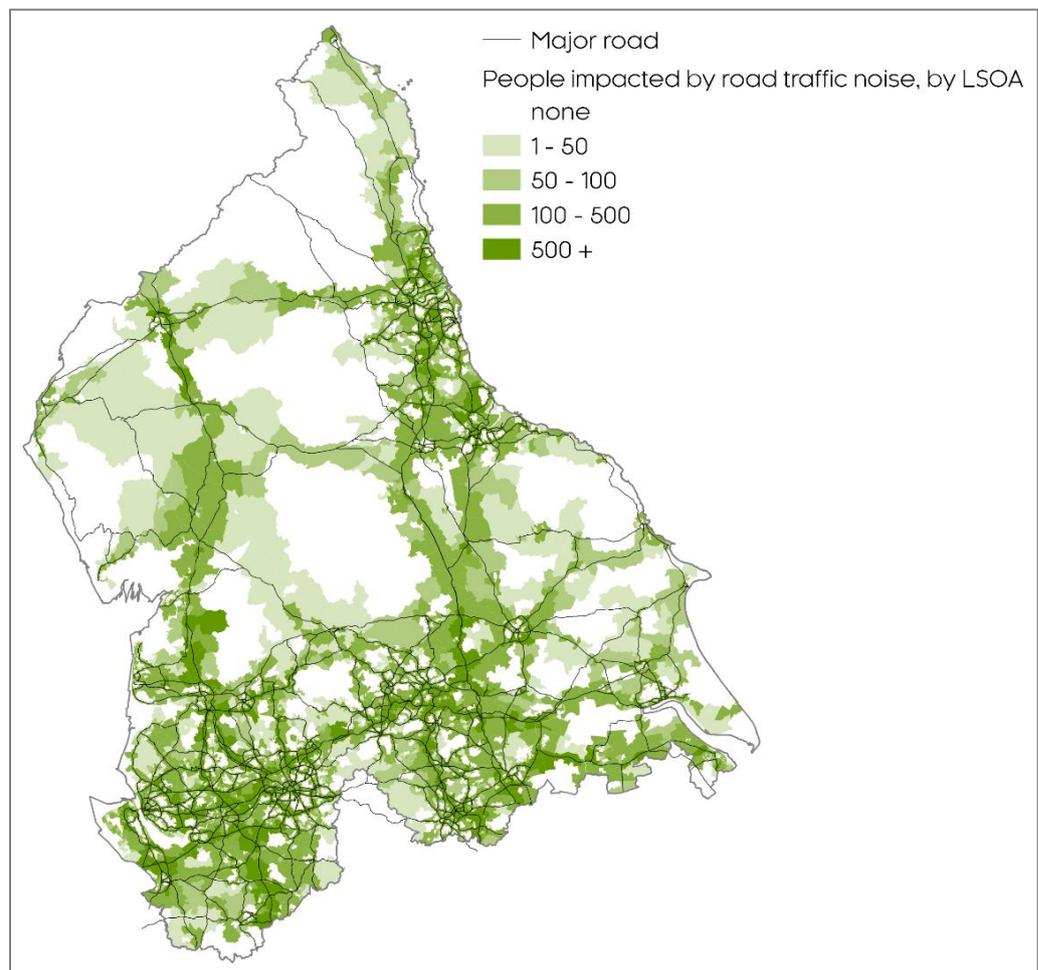
Source(s): Seidler *et al.* (2017); Defra; Cambridge Econometrics analysis.

Over 2.5m people are affected by road traffic noise in the North

Figure 5.23 illustrates the estimated impact that road traffic noise has on the population of the North, by LSOA. Over 2.5m people are affected by traffic noise from roads in the North. In percentage terms, this represents 18% of people in the North West, 15% in Yorkshire and the Humber, and just under 15% in the North East. The high percentage affected in the North West is likely to be linked to large urban centres such as Manchester and Liverpool. The impacts are most concentrated in and near the most densely-populated cities and towns. The human impact of road traffic noise in sparsely populated areas is minimal.

One caveat of the analysis is that impacts on sparsely-populated LSOAs is likely underestimated. This is because the method assumes that people are evenly spread within an LSOA. In reality, LSOAs have an uneven population distribution and residences are likely to be concentrated near major roads. Our estimate is therefore likely smaller than the real figure.

Figure 5.23: People impacted by road traffic noise in the North, by LSOA



Source(s): Seidler *et al.* (2017); Defra; Office for National Statistics; Cambridge Econometrics analysis.

5.6 Severance

This section presents an example application of a method proposed by Ancaes (2013)

Approaches to modelling community severance in relation to transport are still not fully developed. This is because community severance cannot yet be quantified effectively (Mindell & Karlsen, 2012). Nevertheless, impacts resulting from what can be identified as severance are outlined as part of the impact framework (see Section 4.6).

This section presents an application of the method put forward by Ancaes (2013) to measure (potential) severance caused by a road. We present it as a proof-of-concept which TfN may wish to explore further.

Ancaes's (2013) proposed method considers how destinations are separated by a road and how this restricts a neighbourhood's access to those destinations.¹⁶ A resident's potential destinations are all other population centres within walking distance of their neighbourhood. This captures both households where friends and family reside, and facilities and services, such as shops and town centres, which are also population centres.

Severance can be thought of as separating populations ('connections') in walking distance of each other

The calculation of severance involves:

- the number of people affected: the population of the neighbourhood in question
- the attractiveness of each candidate destination: proxied by the population of that destination i.e. as a weight
- the severance value of the road: how difficult it is to cross and how much of a detour must be taken to reach its crossings

Destinations are classed as population centres within straight line walking distance, and two walking distance bands are chosen based on the 'Streets for Life' urban design concept by Oxford Brookes University (Burton & Mitchell, 2006), at 0-500 and 500-800 metres. Destinations between 500-800m have their attractiveness score halved.

The severance value of the road depends on how significant a barrier it represents to those wishing to cross it, which is discussed in more detail below.

Adapting Ancaes (2013), the severance effect of a road on all neighbourhoods can then be calculated as:¹⁷

$$Total\ Severance = \sum_{n \in N} Pop_n \cdot \sum_{d \in D} A \cdot I_d \cdot RSI$$

where:

- n = a neighbourhood within 800m of the road
- N = all such neighbourhoods
- Pop = The population of a neighbourhood

¹⁶ The method could feasibly be used for rail or any other infrastructure that imposes a barrier between two places.

¹⁷ Ancaes (2013) does not articulate a formula, but sets out, descriptively, the input variables.

- A.I = Attractiveness index of a destination, proxied by its population
- d = a destination of neighbourhood n that has been severed by the road
- D = all such destinations
- RSI = Road Severance Index

As mentioned in Section 4.6, the unknowns (which must be defined and then measured) are the attractiveness index and the road severance index. Ancaes (2013) proposes population density as a convenient (and real-world) proxy for attractiveness and, as we suggest above, this could be interpreted as a measure of potential social connections. However, the road severance index remains problematic as a concept. We revisit this below, after presenting our example analysis.

Example: A dual carriageway in Liverpool

The A580 is a dual carriageway that goes through densely populated areas of Liverpool, including Norris Green, northwest of Liverpool city centre. A section of it is shown in Figure 5.24.

Figure 5.24: Severance imposed by Road A580 on Postcode L11 7AS



Source(s): Ordnance Survey 'OpenMap Local', UK Data Service 'UK 2011 census Postcode Headcounts'; Cambridge Econometrics analysis.

Walkable distance both defines and weights the neighbourhoods of interest

Figure 5.24 shows the severance impact of the A580 on the people living in a single neighbourhood, as measured by a postcode, L11 7AS, shown as the red dot at the centre of the concentric rings. The impact on this neighbourhood of the A580 road is measured in terms of lost connections, adjusted for distance.¹⁸ The 62 people living in L11 7AS now have to cross a road to get to any of the pink highlighted neighbourhoods (north of the road). The total

¹⁸ Following Ancaes (2013), people living between 500m and 800m from the origin are given half the weight of those within 500m, as they are further away. Those living more than 800m from the origin neighbourhood are excluded.

population of the neighbourhoods within 500m of L11 7AS (the inner concentric circle), and on the other side of this road is 1,807. The total population of the neighbourhoods 500-800m away (the outer concentric circle) and on the other side of the A580 is 807.

A weighted (attractiveness) score for these separated connections combines those potential connections within 500m (1,807) and those within 500-800m (807 halved = 403). This score is 2,210 (1,807 + 403).

The above gives a severance impact on the postcode of:

$$Severance_{L11\ 7AS} = Pop_{L11\ 7AS} \sum_{d \in D} A \cdot I_d \cdot RSI$$

which translates to:

$$Severance_{L11\ 7AS} = 62 \cdot 2,210 \cdot RSI = 137,020 \cdot RSI$$

Were we to follow Ancaes (2013) at this point, we would then need to quantify the road severance index (RSI) of the A580 for this community.¹⁹ With no consensus on what this index should be (nor any straightforward way to interpret it), we opt not to calculate this term and, instead, focus on the number of (weighted) potential connections severed: 2,210.

The value of 2,210 compares to a total weighted value (i.e. the entire population in the vicinity, not just north of the road) of 7,837 such that 28% of the potential connections are separated by the A580. While not necessarily inaccessible, 28% of the connections could only be reached by crossing the road. The deterrent effect, whether physical or psychological, *may* represent potentially weaker social connectedness/capital.

The approach only identifies potential connections severed...

This population-based analysis could be taken to represent the number of (weighted/equivalent) social connections separated by a road. If one were willing to make this assumption, then this represents a proxy for social capital/connectedness which could then be interpreted in the light of the literature as greater risk of physical and mental ill-health. Were there evidence to link to severance, these would be applied at this point e.g. some change in health or some heightened risk of ill-health in response to more severance. As discussed previously, the lack of evidence precludes this final step, even if the analysis above might help in giving some indication of hotspots.

At best, however, the above is only a risk factor: we cannot observe the connections themselves (e.g. whether these people would necessarily have been connected in the absence of a road) nor can we know what the behavioural response might be (e.g. if people are more willing to walk a little further in other directions away from the road to compensate).

The configuration of walking routes may also be relevant. Here, we consider straight-line distance rather than, say, distance by walking paths. How this

¹⁹ The discussion in Ancaes (2013) goes further to consider how different road characteristics might affect severance in terms of road features but also ability to cross and other physical/psychological factors which may have a bearing.

might change the results is, however, beyond the scope of this analysis; as is any consideration of other transport options.

Other aspects of the method that may warrant future investigation include:

- the definition of a neighbourhood (here, taken to be the population living in a given postcode) and, by extension, the boundary around which the 800m radius can be drawn
- what is a reasonable walking distance. We use 0-500m and 500-800m here after Burton & Mitchell (2006) but this may vary over time and by neighbourhood
- whether demographic factors can be incorporated e.g. to consider the likely greater physical and psychological impact on children and the elderly

Extended example: The A1 in Newcastle

...but may be useful to highlight risks of reduced social connectedness / capital

As an example, this approach could, in principle, thus be applied across an area to understand severance as a function of population density and road configuration. While the analysis still cannot take the step from severance to health, the approach, rooted in population distribution, may help to shed light on potential reductions in connectedness.

Taking the example further, we now apply the approach to a section of the A1 going through west Newcastle. The busy road crosses the edge of the Newcastle metropolitan area, with residential areas on either side. The population of the square area examined is 146,881. Severance, as calculated here, is not affected by any characteristics of the road, such as speed limit or number of lanes, since the methodology used does not have the means to account for these. It is therefore a function only of the sizes of the populations separated by the road. Also, we will only consider connections within 500 metres for (computational) simplicity, although different definitions of an area could be applied.

Figure 5.25 below shows a section of the A1 crossing a densely populated area in Newcastle.

Figure 5.25: Severance imposed by the A1 in Newcastle



Note(s): Connection severed defined as the percentage of total connections within 500 metres of a postcode interrupted by a major road.

For clarity, only postcodes with at least some (potential) severance are shown.

Source(s): Ordnance Survey 'OpenMap Local', UK Data Service 'UK 2011 census Postcode Headcounts'; Cambridge Econometrics analysis.

In total, 524,660 potential connections within 500 metres are on the other side of a major road in the area examined. These are concentrated in areas where both sides of the road are densely populated. Because the map only shows postcodes with at least some (i.e. non-zero) severance, while there is a populated area near the A1 in the south-east part of the map, there is no estimated severance risk here, because the population is entirely located to the south with no-one living north of the road. Some postcodes are more affected, with a higher proportion of their connections severed (up to a maximum of 83%). Higher proportions are observed in postcodes with major roads on multiple sides (see both roundabouts) and bends in the road.

The total number of connections severed should be interpreted with caution, because of significant double counting. A single postcode might lose connection to multiple (n) other postcodes within 500 metres. In that case, its population will be counted as 'severed' n times. For reference, the area examined has a total population of 146,881 people.

An adaptation of this approach could be used to compare the severance value of various road configurations in the same area.

6 Conclusion

6.1 Summary

This report considers the impacts of transport on health and wellbeing in the North of England

This project considered the impacts of transport on health and wellbeing in the North of England, with the aim of improving how such effects might be quantified to inform: the further development of TfN's Strategic Transport Plan (STP), TfN's Decarbonisation Strategy, and TfN's capacity to analyse the impacts of transport in the North.

We divided the work into:

- 1 an evidence review (a review of reviews) to see how strongly identified various the links for ten impacts were, and to assess their amenability for subsequent modelling
 - expert interviews helped with this process, to augment both the causal representation (the system map, as in Appendix A) and the body of evidence reviewed
- 2 the development of an impact framework to operationalise the evidence (where such evidence were suitably robust) in a way that could then be applied to questions of transport, health and wellbeing
 - a spreadsheet accompanies this report, setting out the various evidence, links and data requirements (and availability)
 - our analysis (in Chapter 5) shows how to apply the analysis and datasets we have developed as part of this work

6.2 Impact framework

Through the evidence review we identified three tiers of evidence

Through the evidence review, we identified three tiers of evidence according to the robustness of the quantitative findings and their amenability for further analysis. By this system, we categorised the ten types of impact as follows:

- Tier 1: Evidence from the literature and expert interviews supported by sufficient quantitative data and robust analysis for it to be possible to characterise the identified relations with high levels of confidence.
 - Physical inactivity
 - Incidents and safety
 - Air pollution
 - Limited access to green space, recreation and leisure
- Tier 2: Evidence from the literature and expert interviews is supported by sufficient quantitative data to estimate the strength of the relationship. However, either the data were insufficiently comprehensive, or econometric results were not strong enough, for this to be characterised as a robust result.
 - Noise pollution
 - Severance
 - User experience
- Tier 3: Evidence from the literature review and expert interviews provides insight as to the direction, approximate scale, and nature of the relationship between two or more variables; however no attempt to quantify this has yet been made.

- Limited access to healthcare facilities
- Limited access to high-quality employment
- Environment quality

Some impacts are amenable to analysis...

By this categorisation, Tier 1 impacts are in principle amenable to quantitative analysis of transport. This is reflected in the impact framework and, moreover, these are also aspects in which there tend to be good data on the necessary parts of the causal chain to carry out analysis.

but others face various analytical challenges

Tier 2 impacts present more of a challenge for quantitative analysis because of some (related) combination of:

- weaker or less conclusive quantitative evidence
- more complex chains of causation, possibly with evidence gaps (or unobservables) that make it difficult to operationalise the framework
- limited data availability to combine with the above

While this does not necessarily preclude quantitative analysis, depending on the impact, the degree of feasibility varies from broadly assessable (as in noise pollution) to tentatively, with caveats (as in our test case of severance) to not modellable (user experience).

The remaining impacts (Tier 3) tend to represent more in the way of hypothesised pathways that link transport to specific health outcomes, with little or no supporting quantitative evidence.

The impact framework thus identifies:

- five impacts for which there are sufficient evidence and appropriate geospatial datasets some form of analysis of health impacts (as presented in Chapter 5)
- one impact, severance, for which we carried out some test analysis of how a measure based on population density/proximity might help signal risks of social disconnectedness
- four impacts for which quantitative analysis is not currently possible, with some discussion of the gaps and how they might be filled

6.3 Analysis

Our summary findings from the analysis (in Chapter 5) are as follows.

Four of the six impacts analysed in this report considered the whole of the North of England. The two remaining impacts (physical inactivity and severance) were evaluated at smaller scales due to the complexity of the analysis and/or the availability of data. Where possible, we analysed not only the spatial distribution of health risks but also how these risks are distributed among the population of the North. Table 6.1 summarises the estimated number of people at risk from the health impacts analysed in Chapter 5.

The data (shapefiles) that informed this analysis accompany this report, both as analyses in their own right but also as examples of how such analysis could be carried out in the future.

Table 6.1: Summary of the estimated number of people at risk, by transport-related health impact and geography

Impact category	Impact	Geography analysed	Estimated number of people at risk in geography ('000s)
Physical inactivity	Lower walking and cycling activity	Greater Manchester	163
Incidents and safety	Number of traffic casualties		33*
Air pollution	Higher risk of mortality from nitrogen dioxide		5,880
	Higher risk of mortality from PM ₁₀		5,850
	Higher risk of mortality from PM _{2.5}		5,640
Limited access to green space, recreation and leisure	Higher risk of type 2 diabetes	The North	9,720
	Higher risk of psychosocial distress		200
	Lower self-rated general health		5,750
Noise pollution	Higher risk of hypertension		2,500
	Higher risk of coronary heart disease		2,500
	Higher risk of depression		2,500

Note(s): * This number does not represent those at risk of traffic incidents but the number of traffic casualties in the North for 2019.
 We did not calculate the number of people at risk for physical activity and subjective wellbeing from proximity to parks and severance.
 For air pollution, only the three most harmful pollutants were considered.

Source(s): Cambridge Econometrics analysis.

Physical inactivity

The analysis of physical inactivity suggests that:

- in Greater Manchester, more than 2.6m people have access to a cycle path within 1 km of their home, translating to 61.2 additional minutes of physical activity per week relative to those who live more than 4 km from a cycle path
- parks in urban areas within 0.5 km of one's place of residence are associated with a 1.86% increase in a measure of physical activity per park in range, which we demonstrated as suggesting benefits to residents of Sheffield and Greater Manchester

The evidence points to the value of built environment interventions such as cycle routes and urban parks as ways to stimulate physical activity for those nearby. Insofar as built environment interventions increase access and use of features that promote physical activity within a community, healthier populations should result. However, we note that some of these effects may be quite small in scale, possibly limiting the degree of health improvement.

The principal limitations of the analysis concern the needs to:

- consider the quality of the infrastructure and whether/how it drives physical activity, especially given the finding that, in principle, much of the population of Greater Manchester is in reasonable proximity to a route
- consider access in a more nuanced way beyond straight-line distance i.e. to capture features of the environment and what it really means for travel routes and times/distances

Incidents and safety

Various features of roads and vehicle traffic patterns are associated with the number and severity of vehicle collisions and casualties. For example, average speed, traffic volume, speed variation, and speed difference are all factors shown to affect the occurrence of traffic incidents. Our analysis considered the rate of traffic incidents by local authority and daily traffic volume of major roads in metropolitan districts.

Our deeper analysis of Greater Manchester showed that, while traffic volume was high on major motorways, such as the M60, the bulk of incidents were concentrated on A roads, especially near the urban core of the area. Further, the casualty rate per distanced travelled is ten times lower for motorways when compared to A roads.

The risk of a road traffic incident is highly context-specific, meaning it can be hard to model the risk without a detailed representation of local factors. Further data with a measure of traffic density might be helpful in modelling the risk of traffic incidents. Additional data that identify incidents by point on the map may also be helpful in broadening the analysis.

Air pollution

Air pollutants, some of which are directly attributable to transport, are related to many negative health outcomes that can result in hospitalisation and/or mortality. We analysed six pollutants in the Northern regions to estimate the expected increase in risk of hospital admissions and mortality:

- most of the increased risk of hospitalisation and mortality comes from NO₂, PM_{2.5}, and PM₁₀ emissions. Of these, NO₂ and PM_{2.5} are highly localised,

with maximum effects near the kerb, with implications for road design and pedestrian crossings

- NO₂ concentrations are much higher during the morning and evening rush hours: higher uptake of public transport commuting may thus added health benefits through cleaner air

Increased use of public transportation, especially low-emissions forms of public transportation, could be a means of alleviating the burden of transport-related air pollution.

As well as encouraging modal shift, policies that reduce pollution from motor vehicles or that encourage uptake of vehicles that pollute less (e.g. electric vehicles) could thus benefit human health by reducing emissions. However, pollutants such as PM₁₀ can result from tire and brake wear, which would likely persist if such vehicle use were to continue.

Limited access to green space, recreation and leisure

Proximity to green space and proportion of green space nearby were analysed relative to subjectively and objectively measured health outcomes:

- the amount of green space within 300 metres of one's place of residence has a relationship with improved subjective wellbeing measures
 - focusing on the Manchester area, the urban core of the city has relatively lower access to public green space
 - the population of this core tends to be younger, suggesting that they are benefitting less from enhanced wellbeing
 - However, the analysis of Newcastle showed a very different story, with over two-thirds of the population estimated to live within 300m of greenspace.
- the proportion of green space near to one's place of residence is also associated with improved health outcomes, including lower risks of type 2 diabetes, psychosocial distress, and self-rated general health. When looking at the North:
 - the benefits of decreased risk of diabetes from green space were spread across the region, concentrated in more rural areas and lowest in the southeast corner of the region
 - the benefits of reduced risk of psychosocial distress from green space were wide-ranging through the region, including in urban areas
 - the benefits of reduced risk of self-rated fair or poor general health were most diffuse, concentrated in pockets of forested areas in the northern half of the region

The health benefits of proximity to green space in the North are unevenly distributed. Areas with lowest risks of negative health outcomes are less likely to have populations in the lowest IMD decile.

The North of England is fortunate to have an abundance of green space within its borders, including both urban parks and more rural areas of open or forested green space. Urban areas tend to be at higher risk of having more limited access to green space, so transportation options to increase access would be expected to improve health.

Further analysis on access to mountainous or coastal areas (not defined as green space in this analysis) could be useful, as these natural features most

likely also provide access to recreation and leisure that could accrue health benefits to the population of the North.

Noise pollution

Noise resulting from transport traffic from roads and railways is related to several physical and mental health outcomes, including coronary heart disease, hypertension, and depression. With data on the extent of road and rail traffic noise in the North, the resulting health impacts were modelled for the whole region. We conservatively estimate that over 2.5m people in the North are affected to some degree by road traffic noise, concentrated in the more urbanised southern half of the region and along the major motorway routes. These populations face higher risks of hypertension, coronary heart disease, and depression, relative to areas with low levels of traffic noise.

While road traffic noise pollution does not penetrate into areas very far from major roads, this does affect large segments of the population, as residences and populated areas tend to be found near major roads. Interventions to help reduce noise pollution in residential areas, especially those near major motorways, would be expected to improve health outcomes. The risks due to railway traffic noise are much less widespread.

Further analysis could also look at air traffic noise pollution and consider the interaction of the noise pollution from the three sources, which may point to areas at particular risk.

Severance

TfN was also keen to consider if there might be some way to advance some understanding of the health impacts of severance. Here, the causal evidence chain is broken in the sense that there is some understanding that road traffic can lead to severance and that a lack of connectedness can be detrimental to health; however, the evidence on specifically severance-related health impacts is limited.

In this report, we have carried out small pieces of example analyses that look at how roads might limit how one neighbourhood can reach the people in another within a defined radius (of walkable distance) for both Liverpool and Newcastle. The total population within this radius represents one measure of *potential* social connections and, taking this as one possible proxy for social connectedness/capital, the extent to which the accessible population might be at risk of negative health impacts as a consequence.

Given the limited evidence in the literature, such analysis should be taken as indicative of the health impacts only, but it may be a promising route to better understand the spatial distribution of risk.

6.4 Directions for future work

In terms of how this work might be extended in the future, we identify three main themes:

- 1 the challenges of identifying access and usage, rather than just proximity (which is only a surrogate for access/usage): this concerns in particular physical inactivity and green space
- 2 context-specificity as a challenge to identifying appropriate upstream effects, which is most pertinent to incidents and safety

There are various directions to expand the currently feasible analysis

3 identified gaps in the evidence for impacts (in Tiers 2 and 3) thought to be of importance in understanding the role of transport in health and wellbeing

Indicators of, or insight into, usage would be valuable

As stated in this report, there is a lack of data on usage of infrastructure and green space and, in turn, the determinants of that usage. This is a challenge because, as the cycling routes analysis shows, in principle, large proportions of urban populations are reasonably close to these paths and understanding who makes use of them (and why) and not (and why not) is vital to understanding both the performance of the intervention itself, but also the health outcomes.

In the analysis (and, indeed, in the evidence), proximity is taken as a surrogate indicator of use/access such that being located closer to such infrastructure is associated with improved health, acknowledging that this effect must be mediated by usage.

As such, a fruitful area of further research would be to understand, perhaps in a consumer choice manner, what affects usage of routes and space, to gain a more nuanced understanding of whether and how an intervention might be effective.

Context-specific phenomena likely require expanded models upstream of the health analysis

In the case of road traffic incidents, we also noted the context-specific nature of certain effects. While there may be ways to crudely estimate the upstream causes (in this case, the likelihood of incidents, of varying severity), the challenges of prediction in order to then calculate the consequences has precluded more detailed analysis. Given the complexities, it may be that more sophisticated transport analysis is required before feeding into the health outcomes work.

Gaps in the impact framework may concern impacts of high importance

Finally, the clearest gaps in the impact framework concern those impacts for which both evidence and data are too limited. The following are perhaps most pertinent given the intuition / *a priori* expectation that they are material/important:

- severance, which is an issue of much concern and, as our example analysis suggests, it may be possible to begin advancing work on the social connectedness of populations (albeit under various caveats and assumptions)
- from a wellbeing perspective, user experience (which the evidence shows differs greatly by mode of transport) seems ripe for deeper exploration, not least from a behavioural perspective and in the context of efforts to encourage modal shift – understanding, for example, what is preventing people from switching to lower-stress transport options
- the benefits of access to healthcare tend to be taken as given in the literature, with the presumption that closer is better – while a reasonable assumption, from a strategic transport perspective, understanding the patterns of impact in quantitative manner, rather than simply the (likely) direction of impact, would be useful to prioritise investments
- access to employment, which is increasingly recognised as an important social determinant of health, would also be critical to understand in concert with other economic analyses for the North (not least given the devolution agenda and recent interest in levelling up). Here, there are challenges to

do with identifying data on access and travel (the routing) but also in appreciating the spatial variation in labour supply and demand (e.g. skills/occupational mismatch)

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Appendices

Appendix A System maps

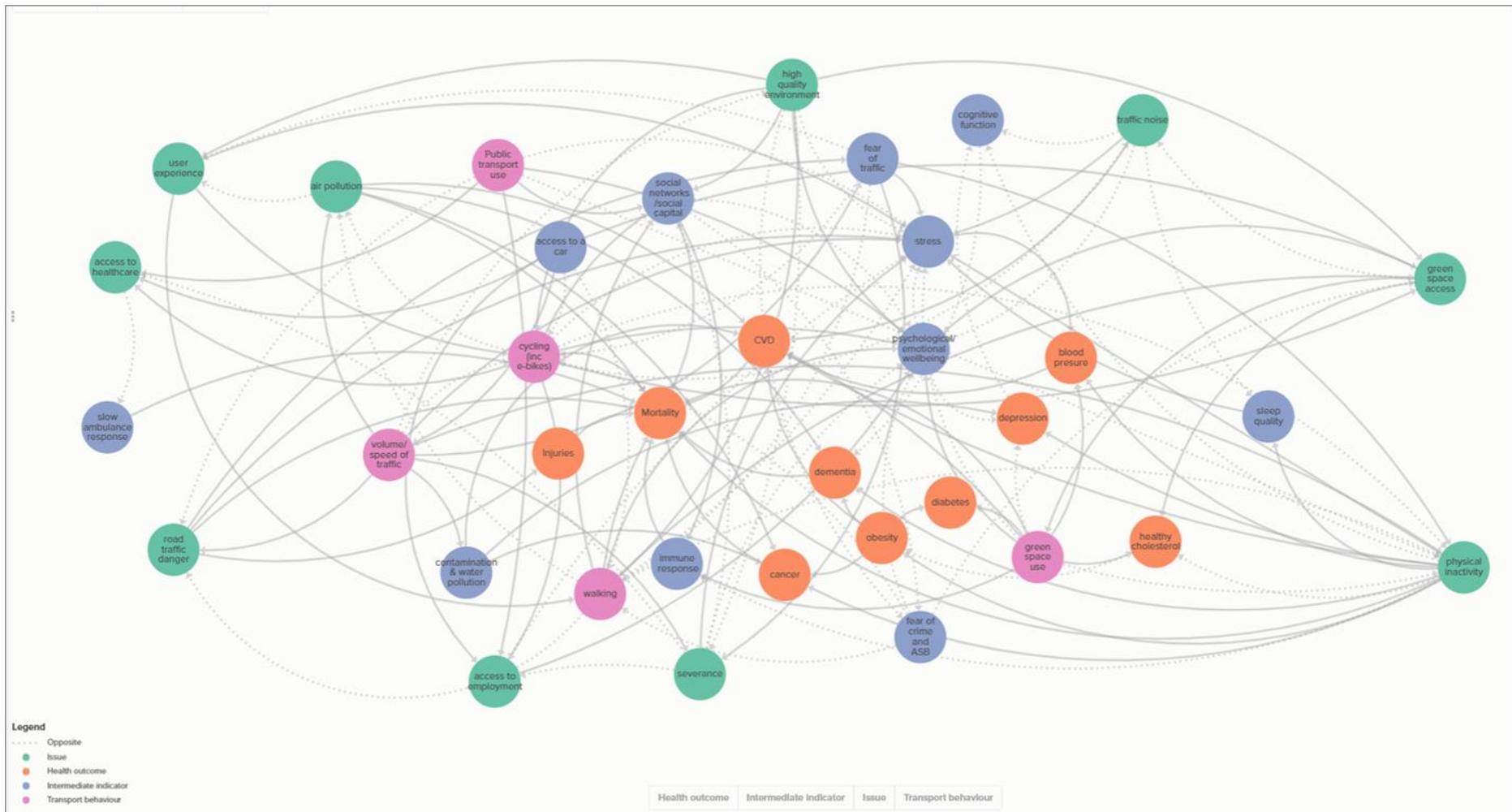
The following pages present the full system map before showing, in sequence:

- links from Tier 1 evidence
- links from Tier 1 and 2 evidence
- links from Tier 1, 2 and 3 evidence

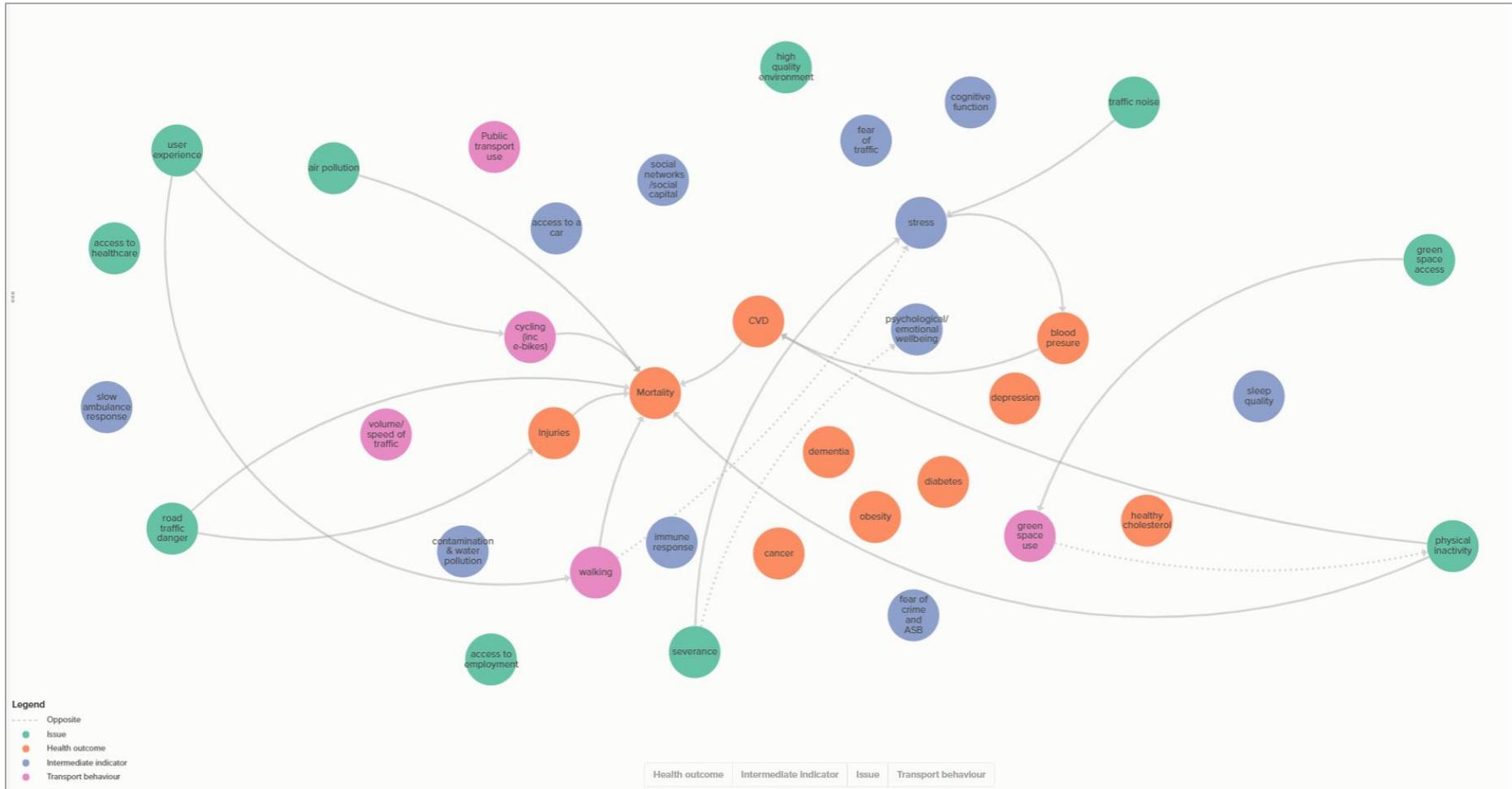
Interactive versions of the system maps are available from:

<https://nickcavill.kumu.io/transport-for-the-north-transport-and-health>

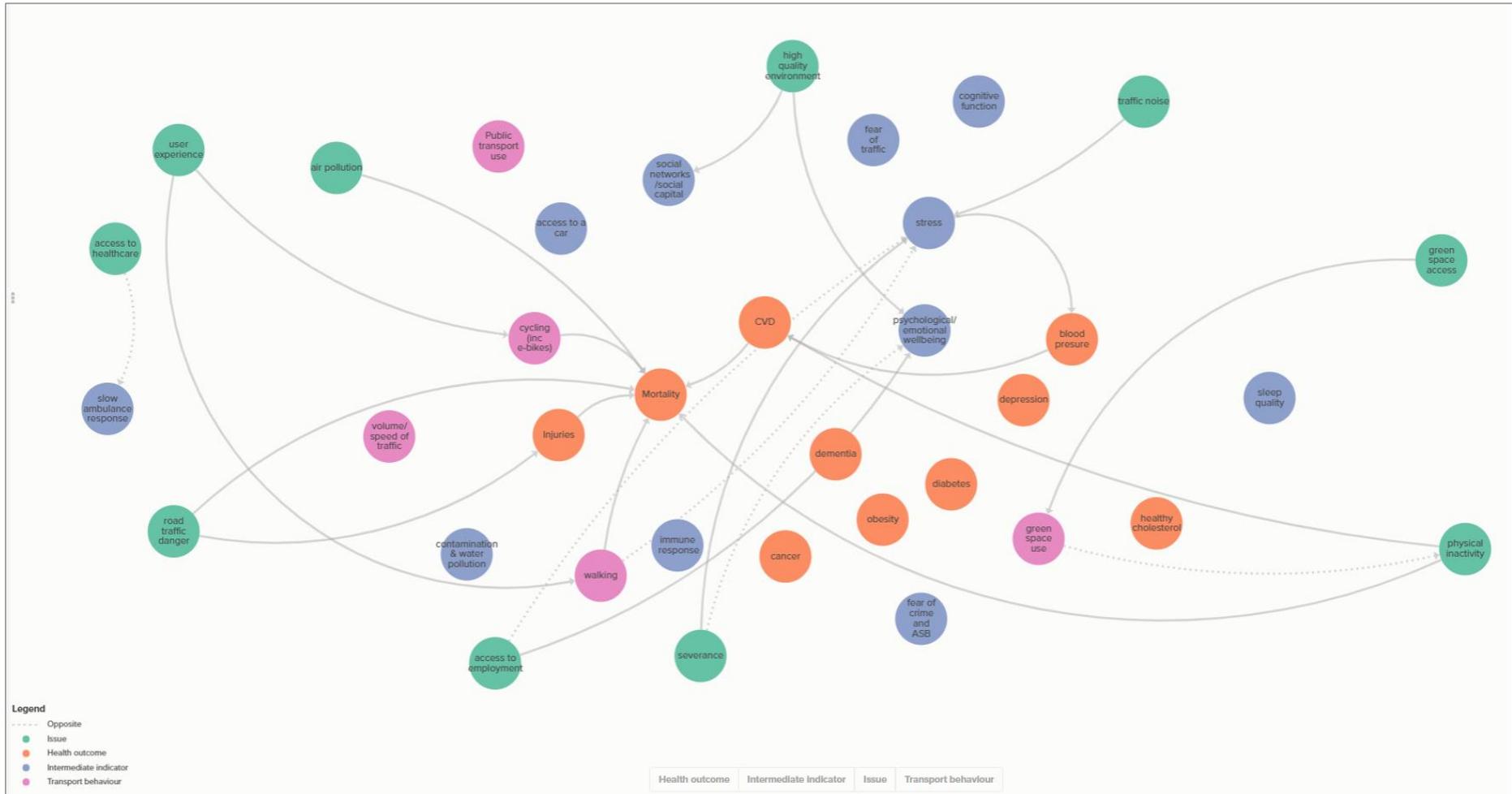
Appendix Figure A.1: Complete system map



Appendix Figure A.3: System map for Tier 1 and 2 evidence



Appendix Figure A.4: System map for Tier 1, 2 and 3 evidence



Appendix B Expert consultations

Appendix Table B.1 below summarises the key discussion points from each expert interview, including (in the two rightmost columns) how the exchange informed an augmented evidence base and system map.

Appendix Table B.1: Transport and health expert consultations

Name	Organisation	Primary expertise	Topics discussed	Additional evidence cited	Amendments to system map
Dr Andy Cope	Sustrans Research and Monitoring Unit	<ul style="list-style-type: none"> • Active travel • Local monitoring and data collection 	<ul style="list-style-type: none"> • Land use planning, as a significant determinant of transport patterns • 20-minute neighbourhoods • Inequalities • Use of green space • Physical activity • Importance of WHO HEAT tool • Growing importance of e-bikes • Mental health and the needs of different transport users • Loneliness and isolation • Potential for local data collection 	-	<ul style="list-style-type: none"> • Link environment to public transport • Added micro-mobility e.g. scooters • Link walking and cycling to social networks

Name	Organisation	Primary expertise	Topics discussed	Additional evidence cited	Amendments to system map
Dr Christian Brand	Transport Studies Unit, University of Oxford	<ul style="list-style-type: none"> • CO₂ • Air quality • Active travel 	<ul style="list-style-type: none"> • Public transport • Air pollution • Differences in wellbeing during an episode (i.e. journey) and how this varies by mode • Argued for the inclusion of carbon emissions in the model • Social capital • Access to healthcare • Fuel/transport poverty (as a cause of stress and ill-health) 	PASTA (Physical activity through sustainable transport approaches) project	<ul style="list-style-type: none"> • Added public transport • Added multiple links especially to wellbeing • Link cardiovascular fitness to cardiovascular disease
Prof Adrian Davis	Transport Research Institute, Edinburgh Napier University	<ul style="list-style-type: none"> • All 	<ul style="list-style-type: none"> • Spatial mismatch: people living away from destinations they need • Environmental quality: lack of evidence on this issue • Electric vehicles • Physical activity and immune response (highlighted by the Covid pandemic) 	-	<ul style="list-style-type: none"> • Added numerous links • Added immune response and links to physical activity and social networks/capital • Links to obesity (cancer etc.) • Link car use to fear of traffic
Prof Jenny Mindell	Department of Epidemiology & Public Health, UCL	<ul style="list-style-type: none"> • Severance 	<ul style="list-style-type: none"> • Quantifying severance • Use of community severance indices • Community severance costing tool • Health impact assessment • Physical activity 	UCL Street Mobility Project Toolkit (see Appendix Section C.5)	<ul style="list-style-type: none"> • Additional links from severance

Name	Organisation	Primary expertise	Topics discussed	Additional evidence cited	Amendments to system map
Dr Francesca Racioppi	Head of the WHO European Centre for Environment and Health	<ul style="list-style-type: none"> All 	<ul style="list-style-type: none"> Walking Cycling Economic assessment Access to education Cognitive function 	Various WHO and other modelling tools (see Appendix C)	<ul style="list-style-type: none"> Added numerous links, notably to walking and cycling Made the case for 'access to education' as a separate issue Added carbon emissions Suggested specific outcome of 'cognitive function'
Prof Karen Lucas	School of Environment, Education and Development, University of Manchester	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Access to health services Journey quality Severance 	-	<ul style="list-style-type: none"> Some additional links from severance
Prof Charlie Foster	School for Policy Studies, University of Bristol	<ul style="list-style-type: none"> Physical activity 	<ul style="list-style-type: none"> Physical activity and links to disease outcomes Green space (both access and use) 	-	<ul style="list-style-type: none"> Added more links to physical activity, notably direct link from walking and cycling to mortality
Prof Nicola Christie	Faculty of Engineering Science, UCL	<ul style="list-style-type: none"> Safety 	<ul style="list-style-type: none"> Inequalities in road traffic casualties Proposed that deprivation should be included on the map Psychological wellbeing (and links to deprivation) Links between cars and crime 	-	<ul style="list-style-type: none"> Added fear of crime Added links to social inclusion Added links public transport and casualties
Dr Kiron Chatterjee	University of the West of England	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Commuting and wellbeing Stress during travel 	Transport reviews: commuting and wellbeing	<ul style="list-style-type: none"> Added links to employment

Name	Organisation	Primary expertise	Topics discussed	Additional evidence cited	Amendments to system map
Prof Mark J Nieuwenhuijsen	Barcelona Institute for Global Health	<ul style="list-style-type: none"> Health impact assessment Air quality 	<ul style="list-style-type: none"> Pathways to health impacts, as in Glazener <i>et al.</i> (2021) Importance of socioeconomic status for health Accessibility Green space The importance of physical activity in most health impact assessments Noise (and the challenges of quantifying) Urban heat islands Use of urban land for transportation 	Glazener <i>et al.</i> (2021)	<ul style="list-style-type: none"> Additional links especially to noise Potentially additional topics, as per Glazener <i>et al.</i> (2021)
Prof Catherine Ward-Thompson	University of Edinburgh	<ul style="list-style-type: none"> Environment 	<ul style="list-style-type: none"> Links between environment and walking and cycling Green space and health Engagement with nature Safety and walking/cycling 	-	<ul style="list-style-type: none"> Amended to 'high quality environment' Added links to walking and cycling Links to emotional wellbeing
Prof Andy Jones	University of East Anglia	<ul style="list-style-type: none"> Walking Green space 	<ul style="list-style-type: none"> Green space access Evidence for links to health outcomes (from his meta-analysis) Physical activity as the main pathway for health benefits (i.e., being active in green spaces), and also factors such as microbiome 	-	<ul style="list-style-type: none"> Added green space use (in addition to access)
Dr Sally Cairns	Institute for Transport Studies, University of Leeds	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Health benefits of employment Absenteeism Evidence on access to employment 	-	<ul style="list-style-type: none"> Added links to employment Suggested absenteeism as pathway

Appendix C Other tools for economic assessment

C.1 WHO Health Economic Assessment Tool (HEAT) for walking and cycling

WHO Health Economic Assessment Tool (HEAT) is designed to enable users without expertise in impact assessment to conduct economic assessments of the health impacts of walking or cycling. HEAT estimates the value of reduced mortality that results from specified amounts of walking or cycling, answering the following question:

If x people regularly walk or cycle an amount y, what are the health impacts on premature mortality and their economic value?

As well as the health benefits from physical activity, HEAT can also take into account the mortality effects of exposure to air pollution and traffic crashes while walking or cycling. HEAT can further assess the effects on carbon emissions from shifting travel by motorised modes to walking or cycling.

URL: <https://www.heatwalkingcycling.org>

C.2 GreenUr: The Green Urban spaces and health tool

GreenUr is a plug-in for QGIS, a free and open-source desktop geographic information system (GIS). GreenUr offers the possibility to measure availability and accessibility of green space in cities. It accommodates algorithms to calculate potential direct health effects of green space, for example, on mental health, and indirect impacts, for example, through ecosystem services.

URL: <https://www.euro.who.int/en/health-topics/environment-and-health/urban-health/activities/greenur-the-green-urban-spaces-and-health-tool>

C.3 AirQ+: software tool for health risk assessment of air pollution

AirQ+ estimates:

- the effects of short-term changes in air pollution (based on risk estimates from time-series studies)
- the effects of long-term exposures (using life-tables approach and based on risk estimates from cohort studies).

URL: <https://www.euro.who.int/en/health-topics/environment-and-health/air-quality/activities/airq-software-tool-for-health-risk-assessment-of-air-pollution>

C.4 Carbon Reduction Benefits on Health (CaRBonH)

The Carbon Reduction Benefits on Health (CaRBonH) calculation tool allows quantification of the physical and economic consequences for human health achieved through improvements in country-level air quality from domestic carbon reductions, specifically policy mitigation actions and measures as

reported in the NDCs submitted by the Conference of the Parties to the UNFCCC in support of the objectives as set out in Article 2 of the Convention.

URL: <https://www.euro.who.int/en/health-topics/environment-and-health/Climate-change/publications/2018/achieving-health-benefits-from-carbon-reductions-manual-for-carbonh-calculation-tool-2018>

C.5 UCL Street Mobility Project Toolkit

The UCL Street Mobility Project Toolkit contains various tools developed by the UCL Street Mobility & Network Accessibility project team to support assessments of community severance in local areas.

URL: <https://www.ucl.ac.uk/epidemiology-health-care/research/epidemiology-and-public-health/research/health-and-social-surveys-research-group/toolkit>



Transport & health policy position

Draft for TfN Board



Context

Among the many legacies of the COVID-19 pandemic has been an unprecedented level of political, media, and public attention to health and wellbeing. For many, conversations about healthcare, the spread of illness, mental health, and wellbeing became part of daily life in a way that they would not have been beforehand. As legal public health restrictions linked to COVID-19 eased, this attention has increasingly turned to access to healthcare, and the impacts of the challenges facing the NHS. These features of public, media, and political attention have added to long-running attention to the extent of health inequalities across the UK, including how issues such as air and noise pollution, physical inactivity, and road traffic incidents disproportionately impact deprived areas and communities.

In 2022/23, Transport for the North (TfN) undertook research with Cambridge Econometrics and Cavill Associates on the impacts of the transport system on health and wellbeing. This research brought together evidence on the range of impacts of the transport system on health and wellbeing, quantified the scale of these impacts, and facilitated analysis of variations in these impacts across the diverse place and population contexts of the North. This research built on the commitment in TfN's 2019 Strategic Transport Plan (STP) to improving "*inclusion, health, and access to opportunities for all*". Drawing on this research and STP commitment, this policy position sets out the health challenge that exists around the transport system in the North, the links between this challenge and other key policy areas, and defines TfN's role in addressing these issues.

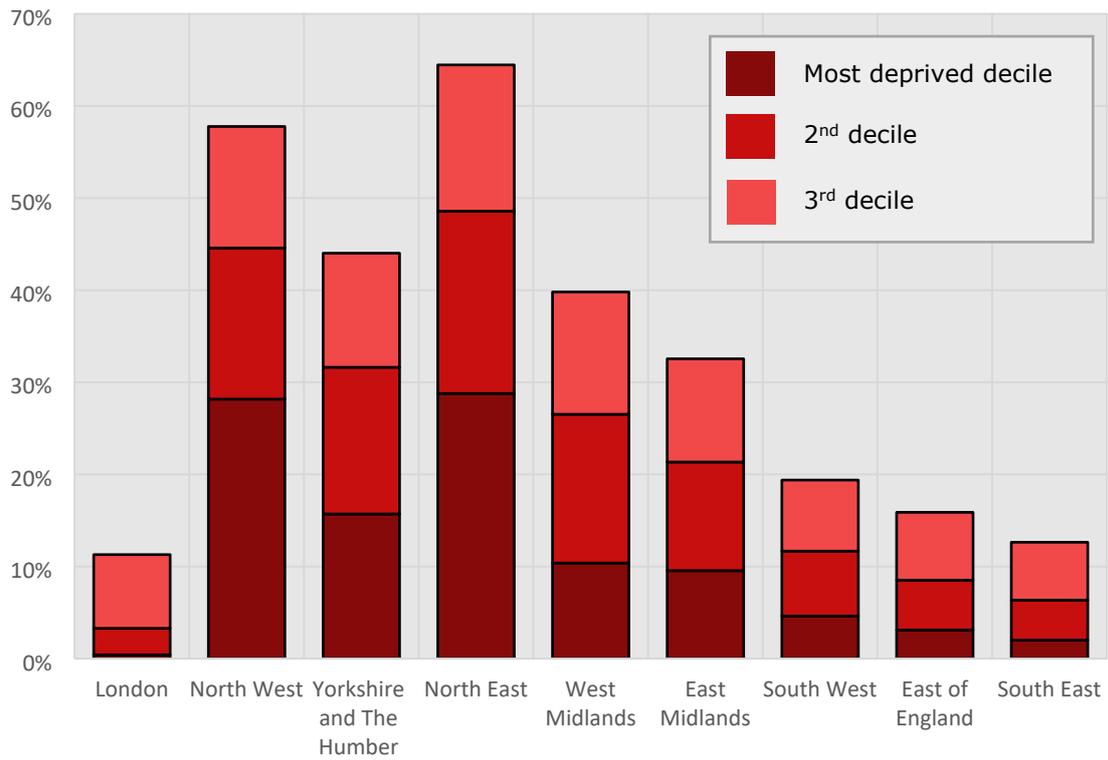
Consistent with wider patterns of regional inequality in England, the three regions of the North face a relatively greater health deprivation. The 2019 English Indices of Deprivation found that 23.9% of areas in the North fall in the most deprived decile for health, and 54.1% in the most deprived three deciles. This compares with 4.4% and 20.2% of the rest of England.¹ Contributing to this, life expectancy at birth and healthy life expectancy at birth is lower in the North than the averages for England as a whole, and the prevalence of obesity among children, levels of smoking among adults, and levels of hospital admissions related to alcohol are all higher in the three regions of the North than the average for England as a whole. Levels of poor self-reported wellbeing and levels of death due to suicide in the North are marginally higher than the average for England as a whole.²

The causes of health and wellbeing inequalities in England are multiple and complex, and are driven in part by wider patterns of regional socioeconomic inequality. However, both TfN's research and the wider body evidence on the determinants of health and wellbeing in England demonstrate that the transport system has a significant role. Broadly, this role reflects: (1) The capacity of the transport system to provide access to healthcare, opportunities, key services, and community life, and through this its role as a determinant of poverty, social connectedness, and access to resources supportive of health, and (2) The wider impacts associated with transport systems, including through pollution, physical activity, and quality of place. These impacts often occur as the negative externalities of transport use by others, rather than being linked to personal use.

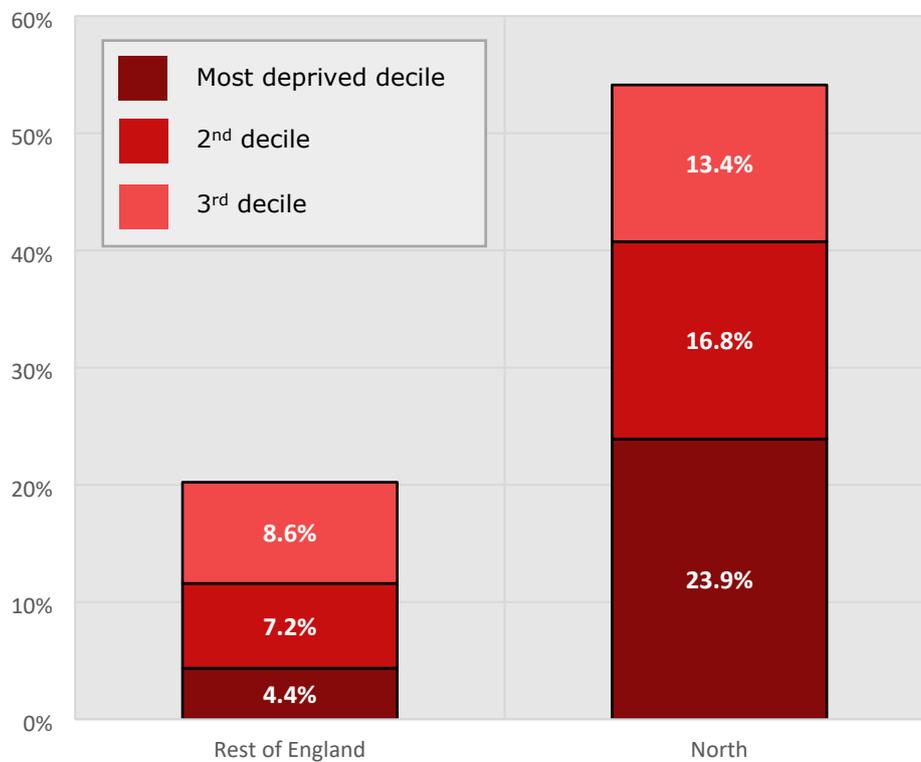
¹ TfN analysis of the 2019 English Indices of Deprivation. DLHC, 2019, [Available here](#)

² TfN analysis of OHID public health profiles. OHID, 2022, [Available here](#)

Population by health deprivation decile by region of England³



Population by health deprivation decile by area of England⁴



³ DLHC, 2019, [Available here](#)

⁴ DLHC, 2019, [Available here](#)

The key impacts of transport on health in the North

There are a large number of ways in which the transport system impacts the health and wellbeing of people in the North. However, not all of these impacts are rigorously quantifiable across this broad geography. Through research with Cambridge Econometrics and Cavill Associates, and recognising TfN's role as a sub-national transport body, this policy focuses on the following links between transport and health and wellbeing:

Incidents and safety: Between 2016 and 2020, the last five years for which data are available, 30,367 people were killed or seriously injured in road traffic incidents in the North of England. Of these, 37.6% were drivers or passengers in cars, 24.3% were pedestrians, and 19.2% motorcycle riders or passengers. Over this same period, 143,451 slight injuries were recorded. Together, this represents a significant burden of mortality and morbidity, and is among the key causes of trauma-related hospital admissions.⁵

Access to healthcare: Statistics published by the Department for Transport (DfT) indicate that approximately 390,000 people in the North cannot access a GP surgery within 30 minutes by public transport, and approximately 510,000 cannot access a hospital within an hour by public transport.⁶ This has the potential to place significant barriers to accessing healthcare among those solely or primarily dependent on public transport, both in the absolute sense and through the knock-on time and cost impacts of these journeys. Owing to wider inequalities in the transport system, this is particularly likely to impact those on lower incomes, those with disabilities, and those living outside of major cities.

Air pollution: Transport – particularly road transport – is a significant contributor to air pollution, particularly nitrogen dioxide and fine particulate matter (PM10 and PM2.5). These pollutants are significant contributors to asthma, diabetes, lung cancer, and dementia, with nitrogen dioxide and PM2.5 pollution estimated to cause 1.14 million and 1.33 million additional cases of disease across England between 2017 and 2035.⁷ Modelling undertaken for TfN indicates that, within the North, approximately 5.88 million people live in areas where nitrogen dioxide pollution poses an increased risk of early death.⁸ Reflecting this, the vast majority of Air Quality Management Areas in the North (135 out of a total of 139) are in place because of nitrogen dioxide emissions from road transport.⁹

Noise pollution: Noise pollution has a range of physiological and psychological impacts, and chronic exposure to noise pollution increases the risk of heart disease, high blood pressure, and depression. These effects occur at a relatively low level of noise, with chronic exposure to traffic noise of only 55 decibels robustly linked with increased levels of coronary heart disease and hypertension. Modelling undertaken for TfN indicates that approximately 2.5 million people in the North are impacted by harmful levels of road traffic noise, the vast majority of whom are in large urban centres. Noise associated with rail is also likely to contribute to poor health, however the impacts are significantly smaller in scale and more diffuse across the North.¹⁰

⁵ DfT, 2022, [Available here](#)

⁶ TfN analysis of DfT Journey Time Statistics data. DfT, 2022, [Available here](#)

⁷ PHE, 2018, [Available here](#)

⁸ Transport for the North, 2022

⁹ DEFRA, 2022, [Available here](#)

¹⁰ Transport for the North, 2022

Physical inactivity: Physical inactivity is a major public health challenge, contributing to heart disease, diabetes, and cancer. The combination of poor-quality active travel infrastructure, car-focused urban design, and high levels of car dependency is a significant limiting factor in levels of physical inactivity. Evidence from the Active Lives Survey indicates that the majority of adults in the North do not undertake more than one significant active travel trip per month, and that a significant minority had not undertaken a significant active travel trip in the last year.¹¹ Incorporating physical activity into everyday life – particularly through walking, cycling, and wheeling for transport – is an effective and well-evidenced public health intervention.

Alongside these five key effects, TfN's research and the wider literature also identifies a number of other impact pathways.¹² This includes:

- The quality of the environment; particularly the impacts of road infrastructure on urban environments.
- The level of access to green space, recreation, and leisure; particularly the impacts of this on levels of physical inactivity, and levels of wellbeing associated with exposure to nature, recreation, and leisure.
- The level of access high-quality employment; particularly the link between transport accessibility and the level of secure and well-paying work among the population.
- The experience of users in the transport system; particularly the level of stress associated with using public and private transport, and the positive wellbeing impacts that can be associated with active travel.
- Community severance; particularly the impacts of road infrastructure and levels of road traffic on social interaction and connections.

In general, these impacts either have a high degree of evidence at the local level, but are not possible to aggregate to the pan-northern geography (as in the case of community severance and the quality of the environment), or have a high degree of evidence for one part of the relationship, but not the relationship as a whole (as in the case of access to high quality employment). Consequently, it is not possible for TfN to monitor changes in these factors over time.

¹¹ TfN analysis of Active Lives data tables. Sport England, 2022, [Available here](#)

¹² Transport for the North, 2022

Challenges

TfN's policy position on transport and health reflects the following challenges:

A complex and multi-dimensional relationship: The previous section describes the complex and multi-dimensional relationship between transport and health. Of the elements of this relationship, five are measurable at the pan-northern geography, and a further five cannot be reliably measured at this scale with the evidence currently available. Further, even where the extent of the health impact can be quantified across the North, this is typically in isolation rather than combination. For example, while it is possible to estimate the scale of impacts from air pollution and noise pollution in isolation, there is less certainty on the combined effects of these forms of pollution.

Impacts on users and non-users: The level of individual exposure to negative health impacts from the transport system has an indirect relationship with the level of use. For example, harmful levels of noise pollution can impact communities living close to major road or airport infrastructure, regardless of their level of use of that infrastructure. Added to this, impacts often occur across modes; for example, the impact of road traffic incidents on people walking and travelling by bike, or the impacts of severance on social connections. These 'negative externalities' are not reflected in the costs of transport use and, owing to inequalities in levels of transport use based on gender, age, ethnicity disability, and income, contribute to wider patterns of social inequality.

Links to multiple policy areas and stakeholders: The impacts of transport on health and wellbeing crosses multiple policy areas and stakeholders. This creates complexities in a context in which budgets and policy are fragmented, particularly where measures to address negative health externalities from transport conflict with traditional transport indicators. For example, measures to address severance and physical inactivity linked to road infrastructure may reduce journey time savings for vehicle users. Further complexity is evident in attributing changes in health to changes in transport policy, and through this assessing the value obtained. For example, attributing changes in levels of physical inactivity as a result of transport policy changes, given the large number of other determinants of physical inactivity that fall outside of transport policy.

A complex relationship with transport decarbonisation: Decarbonisation is increasingly becoming the defining issue in transport policy at all levels. The failure to deliver on net zero will have significant negative impacts on health through extreme weather, damage to the supply of key resources, and natural disasters. However, different approaches to decarbonisation are also likely to have vastly different impacts on health. For example, an approach to decarbonisation that solely prioritises the uptake of electric vehicles is likely to lead to increased levels of physical inactivity and severance. By contrast, a model of decarbonisation that prioritises modal shift to active travel and public transport alongside the uptake of electric vehicles is likely to deliver increased physical activity, lower noise pollution, and lower levels of road traffic incidents.

The need for modal shift: The high levels of car use and car-dominated urban environments widely evident in the North are a key factor in road traffic incidents, air and noise pollution, and physical inactivity, and contributes to severance, poor user experience, and poor-quality environments. Making significant progress in reducing the

negative impacts of the transport system on health requires significant modal shift away from private car use, towards public transport and active travel. However, despite this weight of evidence, the National Travel Survey indicates that there has been no significant progress in achieving modal shift in the North over the last decade.¹³

The role of TfN

As a sub-national transport body, TfN's role is to set a vision for the transport system, and to provide statutory advice on planning and priorities for large scale transport investment. Recognising the scale and significance of the transport system for the health and wellbeing of people in the North, TfN's 2019 Strategic Transport Plan committed to "improving inclusivity, health, and access to opportunities for all", and to "further explore how investment can have a positive impact on people's health". It also called on TfN's partners to "work together to deliver a transport system that promotes social inclusion and improves the health outcomes and quality of life for communities across the North". The STP links this specifically to reducing levels of air pollution, enabling modal shift towards public transport and active travel, and improving access to natural environments.

The STP states that "Air pollution is the UK's largest environmental risk to health, with 5% of deaths in England being attributable to exposure to air pollution. Road transport is a significant cause of air pollution through carcinogenic emissions, high levels of nitrogen dioxide (NO₂) and particulate matter (PM). Children and older people are more susceptible to the effects of air pollution and both long and short-term exposure to air pollution is known to adversely affect health. It is estimated that if no action is taken, the effects of air pollution could cost the NHS and social care system up to £18.6 billion by 2035"

On physical activity, the STP sets out that "The National Institute for Health and Care Excellence (NICE) recommends that active travel and use of public transport should be encouraged. They recommend doing this by making sure there are high quality walking and cycling routes that are convenient, safe, appealing and well maintained." This includes addressing the severance impacts and barriers to active travel posed by other forms of transport infrastructure – particularly road infrastructure.

Population health and health inequalities have intrinsic importance, but alongside this the STP details the role of health in the significant disparity in productivity between the North and London and the South East. The STP set out that "Ill health can reduce productivity through increased absence from work or education, while affecting the ability to perform tasks efficiently and effectively whilst unwell (presenteeism). Around 131 million working days are lost due to sickness absence every year and employers spend £9 billion each year on sick pay and associated costs. Improving health and wellbeing can improve employment rates, raise educational attainment, and increase productivity. Conversely, unemployment is associated with poor mental and physical health."

Links to other TfN workstreams

Decarbonisation Strategy: TfN's Decarbonisation Strategy sets out a trajectory to achieve close to zero carbon emissions from surface transport in the North by 2045, and

¹³ TfN analysis of the 2009 and 2019 National Travel Survey. DfT, 2022, [available here](#).

the policy agenda required to achieve this. Significant and rapid modal shift away from private car use towards public transport and active travel has a key role in this transition. Given the impacts of air and noise pollution, traffic incidents, and severance associated with high levels of car use, this element of the transition is likely to significantly reduce the negative impacts of the transport system on health. Linked to this, TfN's Clean Mobility Visions project is developing a set of evidence-based policies for Local Authorities to reduce carbon emissions by reducing levels of private car use.

EV charging framework: Petrol and diesel vehicles are a major source of air pollution, and the transition to electric vehicles is a key component of reducing these impacts. TfN's Electric Vehicle Charging Infrastructure Framework provides robust evidence on charging demand, and a comprehensive and consistent regional route map towards an effective network. Through this, the EVCI framework reduces investment uncertainty in EV infrastructure, enabling a more rapid and equitable transition to electric vehicles than would otherwise be the case. This, along with modal shift towards public transport and active travel, will deliver a significant portion of the North's carbon reduction trajectory and the required reductions in air pollution - particularly nitrogen dioxide.

Socially Inclusive Transport Strategy: TfN's draft Socially Inclusive Transport Strategy sets out how TfN, Local Authorities, central government, and other stakeholders can act to reduce transport-related social exclusion (TRSE). This includes TRSE linked to health, in which poor access to healthcare services reinforces poor health outcomes, poverty and deprivation. TfN's report on TRSE sets out that 3.05 million people in the North live in areas where there is both high levels of health deprivation and poor access to healthcare services with the transport options available. It also demonstrates that there is a significant gap between the North and the rest of England, with 19.7% of the population at high risk of TRSE specific to health, compared with 16.4% of the rest of England.

Active travel policy position: Walking, cycling, and wheeling for everyday journeys provides significant health benefits. For the user, these benefits principally occur through the physical activity entailed in active travel, but also through the wellbeing impacts of travelling actively - particularly in natural environments. More broadly, increases in active travel lead to reduced levels of air and pollution compared with other modes, and lower levels of severance compared with other modes. TfN's Active Travel Policy Position defines these and other benefits associated with active travel, sets out TfN's ambition to "make cycling and walking a natural choice for shorter journeys", and defines TfN's role in achieving this ambition - alongside Local Authorities, DfT, and Active Travel England.

Spatial planning: The manner in which spaces are designed - particularly the extent to which spaces enable active travel and access to public transport or prioritise car access - shares a number of links to health. TfN's framework outlining the role of Spatial Planning sets out actions for TfN to support those involved in the planning process in rebalancing away from car-dominated environments to promote healthier and more liveable places for all. This complements and builds on the set of actions in TfN's Decarbonisation Strategy and Active Travel Policy Position.

Future travel scenarios: TfN has adopted a scenario planning approach to help futureproof decision-making and establish a detailed and holistic representation of TfN's vision. TfN's Future Travel Scenarios represent strategic factors that are external to TfN's direct control and are used as 'reference case' scenarios to test different TfN strategies

and policies in terms of their performance against objectives. Attitudes to health are included as one of the drivers of change in these scenarios, and are linked directly to the level of uptake of active travel, and the nature of the wider public health policy agenda.

Major roads report: TfN's Major Roads Report sets out TfN's vision for the major roads network as part of a multi-modal transport system. This includes first considering alternatives to road expansion to address the challenges faced in different local contexts, actions to identify and reduce the negative externalities associated with road transport, and a focus on integration with local transport networks. As well as reducing negative externalities through air pollution, severance, and noise, TfN's strategy for the major roads network seeks to maximise economic opportunities and access to key services – both of which share direct links to population health.

TfN's role in transport and health

Vision zero for the major and strategic roads network: TfN will adopt a vision for zero deaths and serious injuries on the major and strategic roads network, and will consider this vision in developing future policy related to this network. This reflects the significant burden of mortality, morbidity, and trauma associated with road traffic incidents, and the extent to which these incidents exacerbate health inequalities linked to age, ethnicity, and income. Linked to this, TfN will work with National Highways and Local Transport Authorities to identify and address common incident sites on the Major Roads Network, including through the support TfN delivers to business case development.

Enhance links with OHID and local Directors of Public Health: TfN will enhance its links with the Office for Health Improvement and Disparities (OHID) and with local Directors of Public Health in the North. This will develop new arrangements for evidence sharing on the impacts of transport on health, and identify evidence gaps of mutual interest. OHID officials contributed extensively to the development of TfN's research on transport, health, and wellbeing, and TfN will build on this.

Enhance evidence on access to healthcare and links to health inequality: TfN's research on transport, health and wellbeing and transport-related social exclusion demonstrate significant inequalities in the level of access to health services across the diverse place and population contexts of the North. However, owing to limitations in the evidence available, it is not currently possible to quantify the link between changes in access and changes in health outcomes. Subject to available resources, TfN will undertake research to address this significant evidence gap.

Develop a severance tool: TfN's research on transport, health and wellbeing developed a methodology to estimate severance effects caused by major road and rail infrastructure. This facilitated estimates of severance effects in two local area examples. However, the level of data required, and the methodological complexity of this approach, means that it is not easily transferable to other contexts. Subject to available resources, TfN will work to overcome these methodological challenges, and provide a transferable tool for Local Authorities to estimate the severance impacts of road and rail infrastructure.

Develop a broader impacts costing tool and estimate for the North: The negative health externalities and wider impacts of transport choices are particularly challenging to

address because they fall outside of the costs faced by users. Reflecting this, TfN will collate existing evidence and, if required, conduct additional research, to establish the whole systems impacts of different transport modes in the North and carry out a comparative analysis against existing pricing models. This is with the intention of supporting policy-makers in decisions on road user charging, parking policy, public transport fares, and investment in active travel.

Support partners in identifying areas with poor access to health services: TfN's TRSE data tool allows Local Authorities and other transport stakeholders to access LSOA-level data on access to jobs, education, and key services – including healthcare. TfN will promote this tool and provide support to partners in using it to identify areas in where there is both poor access to healthcare and high levels of need, as part of wider efforts to reduce transport-related social exclusion and improve the transport network.

Measure progress towards health outcomes: TfN's Monitoring and Evaluation Framework includes several health-related metrics and provides a transparent means of monitoring progress towards the ambitions set out in Strategic Transport Plan. This includes areas such as active travel, road traffic incidents, and air and noise pollution. Consideration of these metrics will be included in an annual Action Plan to review progress towards STP objectives. The focus within this framework is on those metrics that can be reliably measured at a pan-northern level. TfN will publish updates on these indicators and, where required, develop further policy actions to address any emerging gaps.